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COTTON SPINNING

(FIRST YEAR)

THOMAS THORNLEY

UC-NRLF
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COTTON SPINNING

(FIRST YEAR)

BY

THOMAS THORNLEY

SPINNING MASTER, BOLTON TECHNICAL SCHOOL

AUTHOR OF "COTTON COMBING MACHINES"; "COTTON SPINNING CALCULATIONS"
(WITH KEY); "PRACTICAL TREATISE ON DRAWFRAMES AND FLYFRAMES"
("SELF-ACTOR MULE," VOL. I.; "MULE-SPINNING," VOL. II.), ETC.

BEING A COMPANION VOLUME TO "INTERMEDIATE OR
SECOND YEAR COTTON SPINNING" AND "HONOURS,
OR THIRD YEAR COTTON SPINNING"
BY THE SAME AUTHOR

WITH EIGHTY-FOUR ILLUSTRATIONS

THIRD IMPRESSION

LONDON
SCOTT, GREENWOOD & SON
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1908

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PREFACE.

It is now over twenty years since the examinations in cotton spinning were first inaugurated, under the auspices of the City and Guilds of London Institute. Classes in cotton spinning and cotton weaving have now for some years been amongst the most successful of any held under the auspices of the City Guilds. Of the great textile industries, such as silk, woollen, flax and cotton, the latter is by far the most important as regards the number of people who find employment in connection therewith, while at the same time no important industry is more centralised than is that of cotton manufacture in Lancashire and portions of adjacent counties.

Doubtless these latter facts have exercised an important influence for good on the many cotton classes that have been formed throughout the cotton manufacturing districts.

That there is abundant subject-matter for systematic and well-defined study in connection with the cotton trade has been amply demonstrated by the somewhat rapid development and repeated re-arrangement of the syllabuses of the official examinations. For several years cotton spinning and cotton weaving were combined in one general syllabus, and a student joining a cotton class for the first time in his life—and having possibly no

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previous knowledge of the subject—was perforce conducted in his studies during the first session right away from the planting and picking of the raw cotton, not only through all the stages of cotton spinning, but also through those of cotton weaving. When the author of this treatise obtained his first ordinary and first honours certificates under the City Guilds, spinning and weaving were combined in the one examination.

A most important development took place when, in 1889, a complete re-arrangement of the City Guilds' syllabuses was made, and separate classes were instituted in cotton spinning and cotton weaving, this being far more in accordance with the conditions of the industry as at present existing in England.

Following on the same lines, another most important development took place some four years ago in the splitting up of cotton spinning and cotton weaving each into three stages.

Speaking now of cotton spinning alone, a first year student under existing arrangements is only taken to the end of the carding engine, and a second year student is only taken to the end of the actual spinning process.

There is evidently a very wide contrast between the course of study of a first year student in cotton spinning at the present time, and that of a similar student prior to 1889.

In passing, the author may express it as his own individual opinion that some time in the near future the accredited authorities may possibly see their way to extend the scheme of study, so that "textile" diplomas or degrees may be granted.

Quite recently a step in the right direction has been taken by the appointment of Mr. John Crompton to be Inspector of Cotton Spinning and Weaving Classes under the City and Guilds of London Institute. Mr. Crompton is the present Examiner for Cotton Weaving, and acted personally as a leading teacher of weaving for many years. Occupying also an important position in the industry he is in close touch and sympathy with the movement.

It is probable also that classes for the study of special machines and processes may be formed in the near future.

It is one of the principal aims of the present treatises to provide books which shall be absolutely and closely in accordance with the official syllabuses of the City Guilds. To this end, the first book covers practically everything in the first year syllabus—thus meeting the requirements of students for the first year of their cotton class study. In the same way the second book covers the syllabus of the intermediate grade, and the third book covers the syllabus of the honours grade.

It can truly be said that cotton students have been fortunate in having as past examiners such gentlemen as Mr. Butterworth, Mr. Marsden, Mr. Brooks and Mr. Nasmith; and the usually wise selection of questions made by these gentlemen during the last twenty years has rendered the task of the present writer comparatively easy.

In the preparation of these treatises the course has been adopted of selecting previous examination questions and providing illustrated answers.

The questions have been re-arranged according to proper text-book and consecutive mill order, so that questions dealing with the same subjects have been systematically brought together.

In selecting the questions, preference has been first given to those set since the last re-arrangement of the official syllabuses. Afterwards, a careful selection has been made from previous papers, and care taken not to give overlapping answers. Finally, a careful survey of the whole subject has been made, and notes and descriptions have been added upon important subjects which do not appear to have formed the bases of examination questions.

In this way it will be seen that the author has been enabled to cover the subject in a comprehensive and yet somewhat detailed manner.

While these books are of course primarily designed to meet the requirements of teachers of cotton spinning classes and of students attending classes, it will be well understood that the definite arrangement of the subject on the lines of the City Guilds' syllabuses does not in any way detract from the usefulness of the books to the practical mill man, or to any manner of people interested in cotton spinning, whether they attend classes in cotton spinning or not.

A good number of illustrations and descriptions are given that are quite new and have not previously appeared in any treatise.

The thanks of the author and the publishers are due to various firms for the kind assistance they have rendered in the matter of the illustrations—such firms being specified in the descriptions referring to their machinery.

In this connection also the author desires to gratefully acknowledge the assistance rendered by Mr. John Gregoriades and Mr. Frederick Hardman.

THOMAS THORNLEY.

BOLTON, *August*, 1901.

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UNIV. OF
CALIFORNIA

SYLLABUS AND EXAMINATION PAPERS.

[*Below is reproduced the Official Syllabus of the City and Guilds of London Institute for First Year's Cotton Spinning.*]

COTTON SPINNING.

SYLLABUS.—The complete course of instruction is intended to cover three years. Each year's work is indicated in the syllabuses, which form a continuous and progressive course of study, and also define the subjects upon which the examination questions will be founded. Candidates before presenting themselves for the first year's examination (ordinary grade) are recommended to attend a preliminary course of instruction in arithmetic, drawing and elementary physics.

ORDINARY GRADE.

First Year's Course.

1. The geographical position of the cotton fields of the world; the area within which cotton can be commercially cultivated; the physical conditions necessary to its growth and their influence upon the character of the fibre.
2. The general procedure of cultivating and harvesting cotton.
3. The preparation of cotton for the market; ginning and packing; the construction of gins and their operation; the proportions of lint and seed; the influence upon the marketed fibre of faulty ginning and packing.
4. The physical properties of cotton; structure, length, diameter, colour of different varieties; classes and counts of yarn for which each variety is suitable.

5. The objects of mixing cotton; the rules governing the operation; methods of mixing; the construction and operations of the machines used for the purpose.

6. The principles of cleaning cotton; the construction and working of opening and scutching machinery; the functions of various parts; accessory apparatus used in connection with the machines.

7. The principles of carding cotton; the characteristics of the machines used; the construction and operation of carding machines; the functions of different parts; the construction of the clothing used; methods of grinding and stripping; accessory appliances.

8. Calculations of speeds, drafts, etc., in connection with the above-named processes.

[*Below are given two Examination Papers in the First Year's Course.*]

CITY AND GUILDS OF LONDON INSTITUTE.

EXAMINATIONS DEPARTMENT.

TECHNOLOGICAL EXAMINATIONS, 1900.

COTTON SPINNING.

Ordinary Grade.—First Year's Course.

Monday, 30*th April*, 7 *to* 10.

Instructions.

No certificates will be awarded on the results of this examination (first year's course), but the candidates' successes will be notified to the centre at which they were examined.

The number of the question must be placed before the answer in the worked paper.

Not more than twelve questions to be answered.

Answers should be illustrated, as far as possible, with clear sketches.

1. What are the localities of the principal cotton growing areas? What differences exist in their climates, and how do these affect the quality of the cotton? (22 marks.)

2. State what you know about the cultivation and growth of the cotton plant. How do the pods develop, and at what stage are they best picked? (22.)

3. State the mean length and diameter of brown Egyptian cotton. What are the physical reasons for its excellent quality? Which of these cause it to be preferred for good yarns? Why is it economical when so used? (25.)

4. You are desirous of producing a good hosiery yarn of a white colour. What cotton would you use, and what qualities would you look for in making your selection? (24.)

5. What are the commercial terms used to denominate the various grades of American, Brazilian and Egyptian cotton in the market, and what are the chief differences which enable the grades to be fixed? (24.)

6. Attempts are being made to introduce new methods of packing cotton for transport. State fully what you know of these, and the advantages claimed, together with any reasons for making the change. (25.)

7. What cottons would you mix or use to spin (*a*) a cheap soft weft to be used in cloth for raised goods; (*b*) a good quality of ring warp yarn, strong and moderately cheap, of 28's counts; (*c*) a moderately coloured 40's weft of good quality? State your reasons. (25.)

8. What is the principle upon which the dirt bars of opening and scutching machines are constructed and set? What happens if they are not in proper order or are improperly set? A clear and detailed answer is required. (25.)

9. What is the true relation between the fans and dust cages in cleaning cotton? How should the fans act (*a*) when throwing the cotton on to the cages; (*b*) when drawing it on? What are the faults to avoid (1) in the velocity of the fan; (2) in the construction of the passages through which the air is discharged? (26.)

10. Describe and sketch the lap mechanism of an opening or scutching machine. How is a definite length of lap ensured? If the lap machine is used in connection with feeding mechanism at some distance away, how are the two mechanisms coupled so as to ensure continuity of delivery? (30.)

11. Between what points is the draft obtained in a carding engine? Describe the mechanism employed to drive the parts referred to, clearly indicating from whence each is driven. (25.)

12. Describe and sketch the different ways in which the teeth of card clothing are set in the fillet (*a*) looking at the back; (*b*) looking at the edge. What is the object aimed at in each case? (26.)

13. How is a cylinder of a carding engine constructed and prepared for clothing? Describe and sketch the method of constructing the bearings in which its axle revolves, and state what special objects are aimed at. (28.)

14. At about what speed do the flats of a carding engine move, and in which direction? How do they affect the cotton in its passage? How are they driven? (25.)

15. What is "fly," and how is it created? At what points in a carding engine is it formed, how removed, and how often in the course of a day? What would happen if it was not properly removed? (25.)

16. How are the cylinders and doffers of a carding engine ground? What is the relative speed of the grinding roller, and how should it be applied? What happens if it is improperly used? (25.)

17. The feed roller of a scutching machine is 2¼ inches diameter; the worm wheel on its axle has 86 teeth, and is driven by a single worm. The strap is assumed to be on equal diameters of the two cones. The driver cone has a bevel pinion on its foot with 25 teeth, and is driven by wheel on regulator side shaft with 72 teeth. The regulator side shaft is driven by a bevel wheel with 30 teeth gearing with the regulator shaft wheel with 36 teeth. The bottom cross shaft wheel with 12 teeth drives the drop shaft wheel with 65 teeth, the latter being compounded with a pinion with 12 teeth driving the lap roll wheel with 72 teeth. The lap roll is 10 inches in diameter. What is the draft of the machine? (25.)

18. A 12-oz. lap is fed at front of card and is reduced to a 16-hank sliver. What is the draft of card? (22.)

COTTON SPINNING.

Ordinary Grade.—First Year's Course.

Monday, 29*th April*, 1901, 7 *to* 10.

1. Name the principal varieties of cotton grown on the continent of America, distinguish between the conditions of growth, and state what the differences are between the various kinds. (23 marks.)

2. What are the chief differences between cotton grown in Egypt and in Asia, and from what causes do they arise? (22.)

3. What are the principal defects found in cotton as it is picked, and how is its value affected by the weather? (23.)

4. How is the spinning or commercial value of any cotton affected (*a*) by defective ginning, (*b*) by defective baling? (24.)

5. Compare in detail the action of the saw gin and roller gin, and distinguish between their respective action upon the cotton in removing the seeds. (24.)

6. Describe as fully as you can the differences existing between Sea Islands, Uplands, Maranham and Bengal cotton, and say for what counts and classes of yarn each is suitable. (23.)

7. Describe and compare the construction of the ordinary bale breaking machine and a hopper feed machine. When used for the purpose of breaking up baled cotton, what is the difference in the treatment of the cotton? (25.)

8. What are the respective methods of mixing cottons at any stage? What are the essentials sought, and what are the defects to avoid? (24.)

9. Detail the points at which in a combined feeding, opening and scutching plant the cleaning of the cotton takes place, and state what is the character of the waste driven out at each point. (25.)

10. Describe the construction of the pedals applied to a scutching machine. How are they fulcrumed? How should their noses be shaped (if the additional pair of feed rollers are not used) for the various kinds of cotton, and why? Illustrate the last point by a sketch. (27.)

11. Describe and sketch in outline any method in use of

driving the various parts of a combined scutching and lap machine, beginning at the beater shaft. (27.)

12. What are the dimensions of the chief parts of a revolving flat carding engine? After giving the answer to the above query, say what the area of the carding surface would be (*a*) on the cylinder; (*b*) on the working flats. (25.)

13. Describe the arrangement of parts in a carding machine for collecting the web beaten from the doffer and depositing it in a can. How is the doffer comb driven and at what speed? Sketch the mechanism for driving the comb. (27.)

14. At what points in a carding machine does damage to the cotton most usually happen, and what are the principal reasons for its occurrence? (25.)

15. Describe and sketch the stripping and cleaning mechanism used for the flats of carding machines. Describe any recent improvements in the construction of the mechanism, and state its object. (27.)

16. What is the result if the teeth of card clothing are either improperly shaped or roughly or badly ground? Give reasons for your answer. (24.)

17. A mixture of cotton is required. You have the choice of two cottons, A and B. A costs $5\frac{5}{8}$d. and B $4\frac{3}{8}$d. per lb. They are to be mixed in the proportion of two of A to one of B. What would be the total cost of 32,000 lb. of such a mixture, and the cost per lb.? (20.)

18. The doffer of a carding engine is 26 in. diameter. The doffer wheel has 180 teeth and drives by carriers a wheel with 25 teeth on the bottom calender shaft. The bottom calender is 3 in. diameter. The bottom calender shaft drives by a wheel with 37 teeth the coiler change pinion with 17 teeth. The coiler upright shaft is driven by equal bevel wheels, and on its head is a bevel pinion with 21 teeth driving a pinion with 20 teeth on the coiler calender roller shaft. The coiler calender roller is 2 in. diameter. What is the draft between it and the doffer? (25.)

CHAPTER I.

CULTIVATION, CLASSIFICATION, GINNING, BALING AND MIXING OF THE RAW COTTON.

POSITION OF THE WORLD'S COTTON-FIELDS.

Q. 1898. Enumerate the various districts throughout the world in which cotton is grown, in order according to the quality produced, and say briefly what special conditions are necessary to produce the best results?

A. The five great cotton growing districts throughout the world in order of quality are:—

1. The Bahama Islands, being certain islands off the coasts of some of the Southern States of the American Union. In this district may be included a good portion of the adjacent mainland of the State of Florida. This district produces what is known as "Sea Islands" cotton, out of which the very best cotton yarns are produced.

2. Egypt. In the north-east portion of the African continent is grown somewhat extensively Egyptian cotton, which is second in quality only to Sea Islands. It is grown chiefly on lands adjoining the river Nile and in the delta of that river.

3. South American cotton stands next in quality to Egyptian. In Peru are grown Peruvian rough and Peruvian smooth, also a small proportion of cotton from Sea Islands seed, which is, however, inferior to the original Sea Islands, although better than most Egyptian. Brazil gives a fairly large proportion of cotton of rather better staple than American.

4. North America. The Southern States of the American Union give probably 80 per cent. of all the cotton of the world. It is only fourth-rate in quality, but is extremely

suitable for making the vast bulk of cotton goods for all ordinary purposes.

5. In various portions of India a fair amount of cotton is produced, sufficient to make India rank as the second country in the world for quantity of cotton grown. It is, however, the worst cotton grown, and used to any extent for commercial purposes. Various other districts throughout the world give us a moderate amount of cotton, such as the West Indies, Turkestan, the Isles of the Levant, China, Fiji, Tahiti, Queensland, etc.

Fertilising, irrigation and general care and attention to the selection, planting, weeding and picking of the cotton, of course, always improve the quality of cotton. As regards the best natural conditions of growth, there should be, first, a humid atmosphere; second, a good rainfall or an equivalent like the overflow of the river Nile; third, a warm temperature, say, about 70 to 80 deg.; fourth, a good soil, preferably containing salty and caustic substances.

Additional information on this subject is given also in the next answer.

Q. 1900. What are the localities of the principal cotton growing areas? What differences exist in their climates, and how do these affect the quality of the cotton?

A. The principal cotton growing areas of the world are usually arranged in order of importance as to quantity, as below: United States of America, India, Egypt and Brazil. According to the cotton facts of Mr. A. B. Shepperton, China occupies a prominent position. Taken in bales of 500 lb. each, he gives the following table of productions for 1895-96:—

U.S. America	6,700,000	bales.
India	2,200,000	,,
China and Corea	1,200,000	,,
Egypt	1,000,000	,,
South America	228,000	,,

By far the most important cotton growing area of the world is embraced by the following Southern States of the American Union: North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas, Tennessee.

In India cotton is cultivated to a small extent over a very wide area, and almost the whole of India is a cotton growing area.

In Egypt the cultivation of cotton is carried on principally in the districts overflowed by the river Nile, while in Brazil cotton is grown mostly in the districts on the east coast.

In the American Southern States the climate possesses the two essentials of sufficient humidity and heat to greater perfection than any of the other districts, which are more or less deficient in humidity. In India this is especially the case; but in Egypt the absence of rain is largely compensated for by the annual overflow of the Nile. Brazilian cotton benefits by its cultivation near the sea coast. The superiority of the American cotton is also due to the care, skill and enterprise of the planters. The absence or scarcity of moisture tends to give weak and irregular cotton fibres. The American cotton crop for the last few years has averaged nearly 11,000,000 bales, taking one year with another.

CULTIVATION OF COTTON.

Q. 1900. State what you know about the cultivation and growth of the cotton plant. How do the pods develop, and at what stage are they best picked?

A. In preparing the land for a cotton crop it is first broken up. In America this is said to be done in the fall for new land, but is left until spring for old land. The stalks of the old cotton plants have to be broken up and turned under with the plough. For old land, preparing the soil often begins about March, on a dry soil, and after ploughing, the fertilisers are added as required. It is usual in the United States to form elevated ridges or beds of a sufficient distance apart to allow of the full growth of the plant and a passage for the workers. A distance of four feet may be taken as an average. Along these ridges the seeds are sown in drills, or else in small holes at short intervals, and are then covered up. After a few days the young cotton plants begin to show, and a weeding-out process takes place, which may be repeated later as required. When the plant has sufficiently ripened and blossomed the pods are formed, and these develop until they are burst open by the pressure of the seed cotton within. It is best to gather the cotton as soon as possible after bursting of the pod and ripening of the fibre, as neglect of this may cause the cotton to be damaged on the one hand by rain, or on the other hand by over exposure to the sun, and by loading with sand.

Picking may continue more or less until the appearance of frost.

Q. 1898. Why does cotton grown in Turkestan or certain parts of India from Egyptian seed rapidly deteriorate in quality?

A. In Egypt the overflow of the river Nile vastly aids in maintaining the excellence of the cotton, giving a soil eminently suited for the purpose. This special element is, of course, absent in Turkestan and India, and in some parts of these places is not in any way compensated for by rainfall or natural humidity of the climate. The four important natural considerations referred to in the first answer are all more or less defective in the parts of the world referred to. As compared to Egypt, neither the soil, the temperature, nor the humidity are of the best for growing cotton. In some cases these natural deficiencies are supplemented by carelessness and unskilfulness on the part of the growers. In both Turkestan and many parts of India the climate is excessively dry and hot, and this defect cannot altogether be overcome by whatever systems of irrigation may be utilised, although, of course, an improvement may take place.

Q. 1898. Describe the general method of preparing cotton when ripe for the market in the United States, beginning at the plantation and ending at the shipping wharf.

A. When the cotton is sufficiently ripe and the seed case bursts it should be at once picked. Premature picking leads to the presence of an excessively great proportion of unripe fibres, while delay in picking may lead to the cotton being loaded with sand or scorching by the sun's rays. After picking it is usually somewhat loosely gathered up and conveyed to the ginning factory. Ginning is the operation by which the fibres are separated from the seeds upon which they grow. Its necessity is seen from the fact that in 100 lb. of seed cotton as just picked there may be from 65 to 75 lb. of seed, leaving only from one-fourth to one-third of the whole to be good cotton. After ginning comes the important operation of baling. This is performed by the aid of very powerful steam or hydraulic presses, in which the cotton is repeatedly subjected to an enormous pressure, layer after layer, until a sufficiently compact and weighty bale is obtained. The bales of cotton are usually oblong or rectangular, although there is a movement towards making them cylindrical in shape. The bales being made, would be conveyed to the shipping wharf.

Q. 1896. What is the effect of an excessively wet or excessively dry season upon the spinning properties of cotton?

A. An excessively wet season will prevent the cotton pods from bursting or opening. It will stain and dirty the cotton, and will prevent the fibres from ripening as fully as they ought to do. The cotton will probably have to be more roughly ginned than it ought to be, which will injure the staple. A deficiency of rain will cause the cotton to ripen too rapidly, the tube walls of the fibres will not have sufficient time to develop, and the fibres will be brittle and weak, and the cotton will make much waste. A moderately good rainfall is an advantage, as proved by the successful cultivation of cotton in the United States; the warm, moist or steamy atmosphere prevailing there being very advantageous. In India there is a deficiency of rainfall, and the quality of the cotton suffers accordingly. In Egypt also there is a very small rainfall indeed, but this is largely compensated for by the annual overflow of the river Nile. Whether the cotton suffers from an undue proportion of moisture or dryness its spinning properties will be deteriorated, much waste will be made, and there will be more work for the operative. During growth cotton is liable to be damaged by the boll worm and other insect pests which feed upon the leaves, bark and bulb of the plant.

PROPERTIES OF COTTON FIBRES.

Q. 1897. What properties exist in cotton which render it specially adapted for spinning, and in what varieties are these most developed?

A. Briefly stated, these may be given as (1) natural twist,

(2) length of fibre, (3) fineness of fibre, (4) uniformity of fibre, (5) colour, (6) hollow formation of fibre, (7) strength and elasticity of fibre. There is no doubt that foremost amongst these qualifications we may place natural twist. It is pre-eminently this property which renders it so fitted for the production of useful commercial threads. If some of the other commercial fibres were cut as short as the cotton fibre they would become almost worthless, because of the absence of this natural twist in them. There is considerable difference of opinion as to the amount of natural twist per inch. A former examiner in cotton spinning gives it as being from 100 to 300 turns per inch, while a successor of his gives it as being from 300 to 800 turns per inch. The

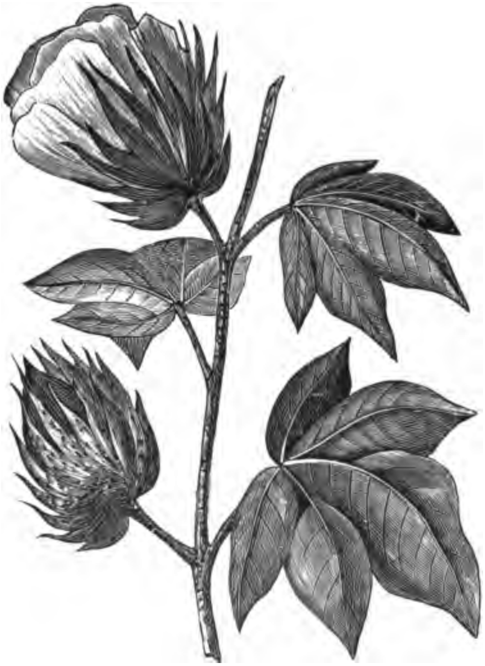

FIG. 1.—Sea Islands, or Long Staple Black Seeded Cotton of Georgia.

most reliable and recent investigations give it as being on an average about 180 per inch in ordinary Egyptian fibres of cotton. There is also a great deal of difference of opinion as to how it is formed, the most recent investigations giving the opinion that it is formed by the fibre collapsing along the line of least resistance when it is sufficiently matured. Of course the value of natural twist consists in the fact that it enables the fibres of cotton to readily cling to each other with great tenacity, so as to form a long thread. The colour is such that it can either be used in the grey trade, without alteration, or it can readily be bleached and dyed to any other colour required. The other properties all play their part in making cotton fibres useful; as, for instance, their fineness

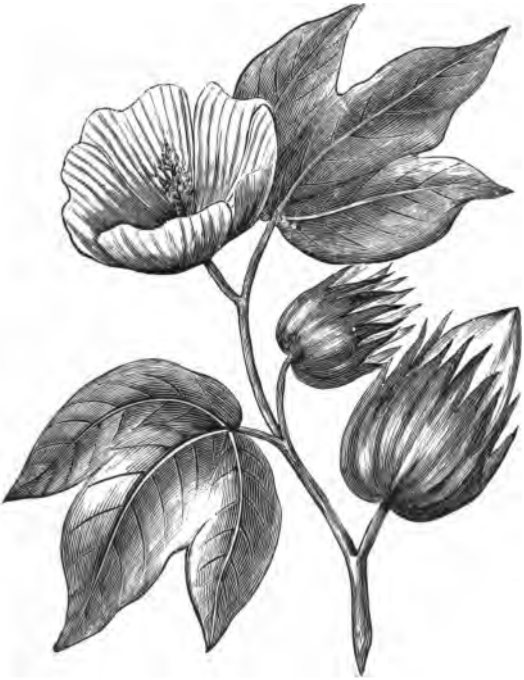

Fig. 2.—Short Staple, or Green Seed Cotton.

enables a great number of fibres to be obtained in the cross section of a thread, and this is generally conducive to the strength of the latter. These various properties are most highly developed in the Sea Islands cotton, which chiefly grows on islands contiguous to the shores of some of the Southern States of the American Union and on the Florida mainland, although a portion of inferior Sea Islands cotton is grown elsewhere. An individual fibre of Sea Islands cotton is not by any means as strong as an individual fibre of good Indian, but the former is the stronger when compared with regard to their respective diameters, or with regard to the number of fibres that can be put into the cross section of a yarn.

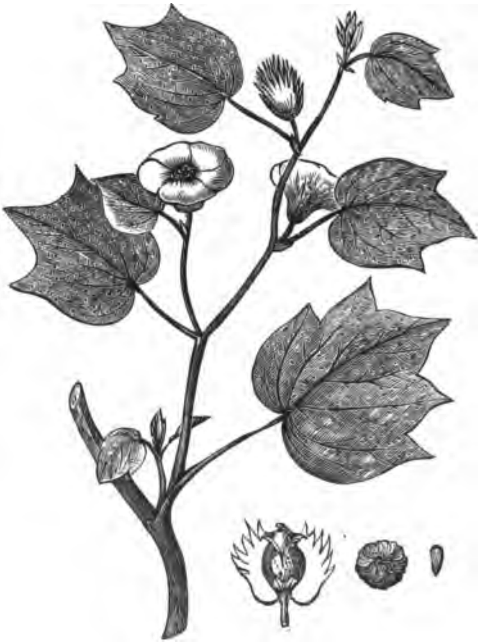

FIG. 3.—*Gossypium Barbadense.*

Q. What functions do the fibres serve in the natural propagation of the plant?

A. The fibres serve as a protection for the seeds. When the cotton bolls have opened and the fibres are ripe, the latter present a light surface to the winds, so that the seeds and fibres are carried by the winds and deposited on suitable soil elsewhere.

Although this may explain how cotton has been carried from one place to another, it must be remembered that in actual cultivation, for commercial purposes, the seeds are more or less carefully selected and planted.

Figs. 1, 2 and 3 show different views of the cotton plant. Fig. 1 represents *Gossypium Barbadense;* Fig. 2, the ordinary American plant; and Fig. 3, another plant of *Barbadense.*

Q. What is the character of cotton that has ripened too rapidly?

A. The tube walls of the fibres have not had time to develop, and the fibres are therefore weaker than when the cotton has ripened more gradually.

Q. Describe a cotton fibre in words or by sketch, and say how its natural configuration becomes useful in making yarn?

A. The sketches, Figs. 4, 5, 6 and 7, are taken from Dr. Ure, and represent cotton fibres longitudinally. Fig. 4 is understood to represent Surat cotton, and Fig. 5 represents Smyrna cotton, shown upon micrometer lines, in glass $\frac{1}{1000}$ of an inch apart. Fig. 7 represents Sea Islands cotton, and Fig. 6 religious cotton, threads of which are worn by Brahmins about their necks. On page 17 the lower sketch is Sea Islands.

A ripe cotton fibre may be defined as a long, tubular, compound vegetable cell.

Its diameter varies from about $\frac{1}{1100}$ of an inch for Indian cotton to about $\frac{1}{1500}$ for Sea Islands cotton. Its average length may be taken at about ·85 of an inch for Indian cotton, 1 inch for American, and $1\frac{3}{4}$ inch for good Sea Islands, and, say, $1\frac{3}{8}$ inch for Brown Egyptian.

It will be thus seen that for Indian cotton a ripe fibre is about 900 or 1,000 times as long as it is broad; for American cotton from 1,200 to 1,400 times as long as it is broad; and for good Sea Islands from 2,500 to 3,000 times as long as it is broad.

Fig. 4.

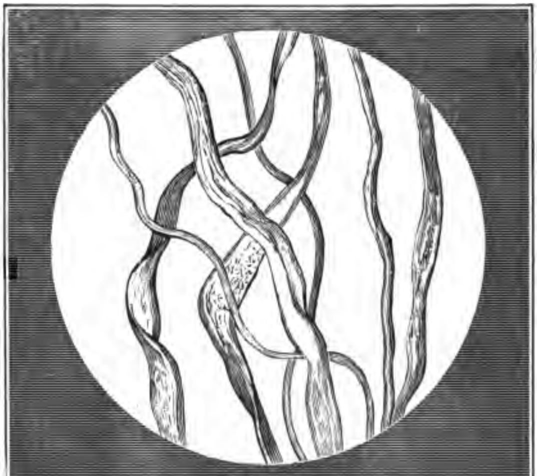

Fig. 5.

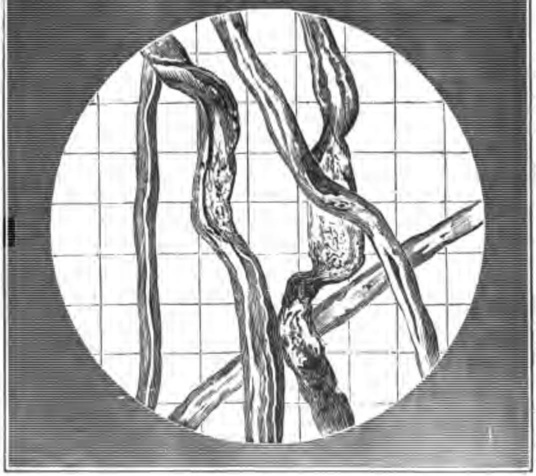

Fig. 4.—Surat Cotton.

Fig. 5.—Smyrna Cotton, shown upon the micrometer lines, in glass $\frac{1}{1000}$ of an inch apart.

-12

Fig. 6.

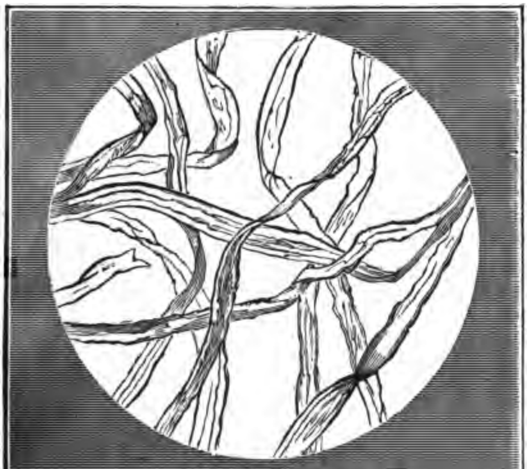

Fig. 7.

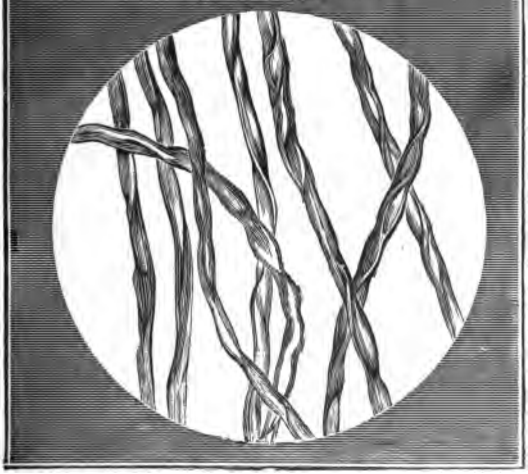

Fig. 6.—Religious Cotton, threads of which are worn by the Brahmins round their necks.

Fig. 7.—Sea Islands Cotton, of which muslin and bobbinet lace are made.

Unripe fibres are flat, ribbon-like and destitute of natural twist, as shown.

A ripe fibre somewhat resembles a flat, twisted ribbon, with corded edges when viewed lengthways.

It is a long, cellular filament, with thickened walls, and having a central cavity reaching almost to the apex, or part farthest from the seed.

A ripe cotton fibre is about one thickness for, say, nineteen-twentieths or so of its length, and then tapers and rounds off abruptly.

A cotton fibre is composed of a substance termed cellulose, the chemical formula for which is $C_6H_{10}O_5$, which means six atoms of carbon chemically combined with five molecules of water.

As before stated, it is principally the natural twist of the fibre which causes them to cling to one another in the processes of spinning.

Q. Describe the difference between a perfectly developed and ripe cotton fibre, an unripe one, and an imperfectly developed one.

A. In an unripe or *dead* fibre there is little or no natural twist; and what have been termed the "corded" edges of the fibre are absent, and the fibres are then flat, ribbon-like and weak.

An imperfectly developed or *half-ripe* fibre naturally comes between a dead fibre and a fully ripe one. It possesses the properties of a ripe fibre to a partial extent. The natural twist, the thickness of fibre wells, the roughened edges and cylindrical structure are more strongly marked than in a *dead* fibre, but not so strongly as in a *ripe* fibre.

Because of their flat, ribbon-like character, neither *dead* nor *half-ripe* fibre will take dyestuffs as readily as ripe fibres.

Unripe fibres cling to the shell more than ripe ones, and are more liable to suffer damage in the ginning and scutching processes.

Fig. 7 (*a*) shows transverse sections of good fibres of some of the best known cottons drawn approximately to scale.

At A are Sea Islands fibres, at B and C are Egyptian fibres, and at D are fibres of American uplands cotton.

Q. 1898. What is meant by "staple" when applied to cotton? State how you would proceed to ascertain it in any given sample, and if the cotton was Texas what would you expect it to be?

A. Staple being taken as the length of the fibre, it may be said that the common method of ascertaining it is to hold a small portion between the thumb and fingers of one hand, while with the thumb and fingers of the other hand some of the projecting fibres are pulled from the portion of cotton being held. This operation is repeated several times until a few fibres are obtained from which the approximate length can easily be judged, as they are made parallel by the drawing operation. To be more sure of the length the fibres could be placed on a rule, divided into sixty-fourths of an inch. Texas cotton is about one inch or ·9 average length of staple.

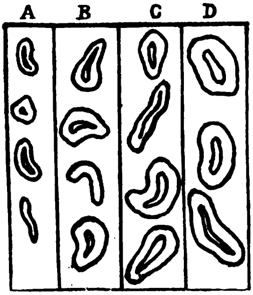

FIG. 7 (*a*).

Q. 1898. Are regularity in pitch and a greater number of convolutions always found in conjunction with a cotton fibre of small diameter? If not, give any instance to the contrary.

A. It is a general rule that cotton fibres of small diameter contain more twists per inch than thicker fibres. There are, however, exceptions to the rule. For instance, unripe fibres may be thin and yet the natural convolutions may be conspicuously absent. Again, cotton grown from Sea Islands seed in various parts of the world is often very irregular in its properties. Fijian Sea Islands, for instance, may be quite of small diameter and yet be very irregular and deficient in convolutions.

Q. 1900. State the mean length and diameter of brown Egyptian cotton. What are the physical reasons for its excellent quality? Which of these cause it to be preferred for good yarns? Why is it economical when so used?

A. Many students stumbled with this question in not clearly understanding what the examiner meant. The average length of fibre may be taken at about 1·3 inch and the diameter at about $\frac{1}{1400}$ inch or so. The annual overflow of the river Nile provides a splendid soil and sufficient moisture for the growth of the good fibre. Apart from the soil and climate, the length, regularity and comparative fineness of fibre, and the colour and extent of natural twist all combine to make brown Egyptian a high class cotton. In these respects Egyptian cotton is second only to Sea Islands, and is often superior to that cotton in regularity of staple and freedom from nep and ease of working. We are not aware that it is particularly easy or economical to pass Egyptian cotton through the various processes as compared with a fair quality of ordinary American cotton. Although Egyptian cotton comes next in quality to Sea Islands, it is vastly cheaper and easier to make yarns from the former than from the latter. Although less waste may be made in the blowing-room, the writer has known 7 per cent. waste to be taken out of cards on Egyptian cotton. The cotton crop of Egypt is mostly of the brown kind.

Q. 1896. Compare the physical properties of Broach, Uplands and Egyptian cotton, and say for what classes and counts of yarn they are respectively most suitable.

A. Broach is an Indian cotton, and therefore only of very moderate quality; Uplands is an American cotton, and therefore of a somewhat better quality than Broach; whilst the Egyptian is a much better cotton than either of the other two. Broach cotton is, however, one of the best Indian cottons although it is rather short in staple, say about $\frac{7}{8}$ inch average length. It fetches a higher price than some Indian cottons with a longer staple, because it is stronger, cleaner and more elastic. It owes most of its good qualities to having a comparatively good soil pretty well irrigated. It will do anything up to about 26's or 28's.

Uplands is a good weft cotton suitable for numbers slightly higher than 40's. Its fibres are not strong, but they are soft and pliable, and there is not much dirt in the cotton. It is a white cotton, and will mix well with other cottons, and has a staple about one inch long.

Egyptian cottons are generally divided into three classes —Gallini, Brown and White. They are given here in the order of their quality. Brown Egyptian is grown in far larger quantities than the other two, and will spin anything, say, up to about 140's. Egyptian cottons are therefore distinguished by length, strength and uniformity of fibres. Their chief defect is that there are always present in them considerable proportions of short, hairy, undeveloped fibres. They depend for their moisture principally upon the annual overflow of the Nile. A good overflow means good cotton and plenty of it; a poor overflow means the opposite.

Q. 1897. Name the differences between rough and smooth Peruvian cottons, and say what purposes they are best suited for respectively.

A. In smooth Peruvian the fibres are smooth, soft and pliable, whereas in rough Peruvian they are harsh and hairy. The possession of the qualities mentioned make smooth Peruvian better fitted for wefts ranging, say, anything between 38's and 72's counts of yarn. It will mix well with the better classes of American cotton, as, for instance, with Orleans, being, however, longer in fibre than the average Orleans, say 1¼ inch average. Many deliveries contain a rather large quantity of unripe fibre and also nep. Rough Peruvian may be used for about the same numbers as smooth, but is more for such yarns as are used by hosiery manufacturers. Whereas the ordinary American and most other cottons are replanted every year, this gives good crops several years in succession, although the second and third years are the best. In this respect it resembles samples of Queensland cotton sent to the author by the manager of the Queensland Cotton Manufacturing Company in Australia some time ago. Practically all the crop of rough Peruvian is used to mix with wool, as it more resembles wool than ordinary cotton.

Q. 1900. You are desirous of producing a good hosiery yarn of a white colour. What cotton would you use, and what qualities would you look for in making your selection?

A. It is considered that Brazilian and Peruvian cottons are very suitable for the processes of hosiery manufacture, and we may say that such a cotton as Ceara or Peruvian would make a good yarn of a white colour. Mr. Walmsley says that for hosiery yarns to average about 10's a great deal of Tinnevelly Indian cotton is used, mixed with a little middling Orleans, the quantity of the latter increasing with the quality of the yarn. It is the writer's experience that a great deal of good hosiery yarn is spun from brown Egyptian without the cotton being specially selected for that purpose. Spinning firms receive orders for such yarns and put the required number of spindles on the work, making very little difference excepting in spinning it softer twisted.

Q. 1899. Suppose you want to spin a wiry twist yarn of a white colour, about 32's counts, what cottons would you use? Give full reasons for your answer?

A. Some students would undoubtedly give rough Peruvian as an answer to this question, but on the high authority of Mr. Shepperton this cotton is seldom used, except for mixing with wool. If the 32's yarn were required to be exceptionally good it might be suitable to use a Brazilian cotton, such as Ceara, Paraiba or Maceio. These cottons are noted for giving a wiry nature to the yarn produced from them. To make such yarn pay, however, a fair price would have to be got for it. The vast bulk of 32's twist yarn is spun from American cotton.

MIXING OF COTTON.

Q. 1899. A cheap mixing for 28's weft yarn is required. What cottons would you select for the purpose, and in what proportions would you mix them?

A. For a cheap 28's weft it would answer very well to make the bulk of the mixing in England from Uplands or Mobile American—more especially the latter. The rest of the mixing might be made up of Indian, *i.e.*, if the yarn is only required to be of an inferior kind as suggested by the question. Mobile is somewhat worse than Uplands, and is a good deal used for wefts up to 30's and slightly higher. It is generally somewhat dirty, damaged by ginning, very leafy, and often contains a large amount of moisture. The average length of fibre may be taken at $\frac{7}{8}$ of an inch. For a cheap 28's weft we might use all of this cotton, and at the mill go in for quantity of production, or we might use, say, two-thirds Mobile and one-third of Indian Dhollerah, or, say, three-fourths of Mobile and one-third Dhollerah. The latter cotton of itself would not satisfactorily spin 28's, but may be added in moderate quantities to the American. Its colour and length of fibre agree sufficiently with the Mobile, and its price per pound is very moderate, as also is that of Mobile. In America it would probably pay best to use very little Indian, or even none at all.

Q. 1899. Is it advisable to mix brown Egyptian and Pernam, or Texas and Broach, or Texas and Dhollerah, or Gallini and Orleans cottons?

A. The deep or golden tinted colour of brown Egyptian cotton precludes it from mixing with Pernams cotton. In addition the fibres of the latter cotton are harsher and more wiry than the former, and the fibres of the Pernams are shorter than those of the Egyptian, which facts are also against their satisfactory blending. As regards Texas and Broach, the latter is an Indian cotton of rather short staple —say average of $\frac{7}{8}$ of an inch. It fetches a higher price than most Indian cottons, because of being cleaner, stronger and more elastic, being—for India—grown on a good soil, pretty well irrigated. It may be taken that Texas and Broach in actual practice are very seldom blended together, although it might be possible to do this to a limited extent, owing to the similarity of most of their qualities, and to the fact that each is browner in colour than other cottons from the same country. It is much less likely that Texas and Dhollerah would be mixed together, as the latter is much whiter in colour, besides being dirtier. It would not do to mix Gallini and Orleans together, because the former is superior in nearly every respect, and also because there is a great difference in colour. It is scarcely worth discussing Gallini, because it is now seldom in the market.

Q. Which are better, small mixings of cotton or large? Give the reasons for your opinion, and briefly describe how you would proceed to mix, say, twenty bales of Low Middling Orleans and ten bales of Dhollerah?

A. It is usually best to have the mixing as large as the size of mixing-room, capital at disposal or state of the cotton markets render advisable. Large mixings tend to give uniformity in the yarn, since every lot of cotton is more or less different from others, and even the bales in the same lot or the portions of the same bale may vary to some extent. By standing in the mixing the fibres tend to loosen themselves somewhat, and if too damp there is a chance for the cotton to dry.

In the case mentioned it would probably be best to pass each lot of cotton through the bale-breaker, and make a mixing from it separately, also to pass each lot of cotton through the opener by itself. At the scutcher two laps of the Orleans could be put with one lap of Dhollerah.

Q. 1899. Suppose that you are examining a sample of cotton, and you find it possessing the following characteristics: staple, $\frac{7}{8}$ inch to inch; colour, slightly creamy; strength, moderate; flexibility, good; elasticity relatively to strength, large—what variety possesses these peculiarities, and what class of yarn would you spin from it?

A. To quote the examiner: "Uplands cotton consists of fibres which are very pliable and elastic, and of a white or slightly creamy colour. Its mean length is a little under an inch, and its diameter equal to Orleans. As it is very soft, however, it is not so strong as the other varieties grown in the United States." This appears to answer the properties of the question as well as any cotton, and it is well known that Uplands cotton is extensively used for medium numbers of weft yarns, say up to between 40's and 50's.

Q. 1897. Supposing you had to make a mixture for 28's twist from American and Indian cottons, what varieties would you select, in what proportion would you mix them, and how?

A. Texas and Hinghunghat would probably make a satisfactory and economical mixing for 28's twist, say in the proportion of three bales of Texas to two bales of Hinghunghat. They differ very little in average length of staple, the American being about an inch and the Indian rather longer, say $1\frac{1}{32}$ inch average length. The Hinghunghat is, however, dirtier than the Texas, and it would be a matter for consideration as to whether it would be the better plan to mix it in

By permission the two following tables are taken from Messrs. Hetherington's excellent catalogue:—

A LIST OF COTTONS AND THEIR ADAPTATION FOR SPINNING DIFFERENT NUMBERS OF YARN.

From the Lowest to the Highest Numbers.

Best Sea Islands . .	. . . . . .	120's Upwards.
Best Egyptian and the Shortest of Sea Islands	. . . . . .	80's to 120's.
Peeler (American) and Soft Egyptian . .	. . . . . .	60's to 80's.
Orleans, Texas and Soft Peruvian . .	These two classes are mixed together as the abundance or scarcity of each class prevails, but it is found that rough and smooth staples do not incorporate well, and hence do not make the best yarn.	40's to 60's.
Pernams, Paraibas, Maranhams, Maceio, Rough Egyptian and Rough Peru . .		40's to 50's.
Puerto Cabello (W.I.[1]), Surinam and Brazilian Peru . .	The lower classes of American are often mixed with these varieties, Georgia or Boweds, etc., mix best with Dhollerah, Broach, Oomrawuttee, etc., but stronger kinds are often used.	30's to 40's.
La Guayran (W.I.), Ceara (B.[2]) and Aracaiju (B.) . .		26's to 36's.
Dhollerah, Dharwar, Broach, Oomrawuttee	The strong low classes of American are best adapted to mix with West Indian, Rough Brazilians, Smyrna, African, etc.	16's to 28's.
Smyrna, African, Persian	. . . . . .	10's to 16's.
Comptha, Bengal, Madras, Rangoon . .	. . . . . .	Very Low Numbers.

[1] West Indian. [2] Brazilian.

There are several varieties of cotton not named in this list that would mix with one or other of the above classes, but this must be left to the discretion of the person buying such cotton.

COMPARISON OF LENGTH OF STAPLE.

Country of Growth.	Variety.	Length of Staple.			Mean Diam. of Fibre.	DESCRIPTION.
		Max.	Min.	Mean.		
		In.	In.	In.	In.	
America	Sea Islands	1·80	1·60	1·70	$\frac{1}{1562}$	A fine, silky, regular cotton of several varieties, American being best.
	Florida Island	1·85	1·30	1·58	,,	
	Upland	1·20	1·00	1·10	$\frac{1}{1290}$	Soft and rather short in staple; usually clean and best adapted for weft.
	Mobile	1·20	0·90	1·05	,,	
	,,	1·20	0·90	1·05	,,	
	Texas	1·00	0·70	0·85	,,	Firmer in staple than the above; but contains more leaf and is less bright in appearance.
	,,	0·95	0·70	0·82	,,	
	Orleans	1·20	1·00	1·10	,,	The best and most regular of all the American cottons. Some lots are very white, but leafy; others of a creamy tone, but clean.
Brazil	Pernams	1·50	1·20	1·35	$\frac{1}{1265}$	
	,,	1·40	1·10	1·25	,,	
	,,	1·30	0·90	1·10	,,	Pernams to Maranhams are Brazilian cottons; and, as a rule, are harsh in staple and give a wiry feel to yarns into whose composition they enter.
	Ceara Aracati, etc.	1·30	1·00	1·20	...	
	Paraiba	1·30	1·10	1·20	...	
	Santos	...	...	...	...	
	Bahia	...	...	...	...	
	Aracaiju, etc.	...	...	...	...	
	Maceio	1·30	1·10	1·20	...	
	Maranhams	1·30	1·00	1·15	...	
		1·30	0·90	1·10	...	
Egypt	Egyptian	1·60	1·40	1·50	$\frac{1}{1526}$	Brown Egyptian is soft and silky, whilst the white is usually hard and harsh.
	Gallini	1·50	1·20	1·35	...	
	,, brown	...	...	...	...	
	,, white	...	...	...	...	
	Smyrna	...	...	...	...	Harsh in staple, and characterised by its irregularly twisted fibres.
	Greek, etc.	...	...	...	...	
	Fiji—Sea Island	1·90	1·25	1·70	...	Very irregular in staple.
	Tahiti—Sea Island	...	...	...	...	
	West Indian	1·60	1·30	1·45	...	Fair in staple but cannot be relied upon through successive seasons for uniformity of colour.
		1·40	1·20	1·30	...	
		1·30	1·10	1·20	...	
	Haytian	...	...	...	...	
	Laguayran	...	...	...	...	
	,, Sea Island	...	...	...	...	Exotic.
	Peruvian	...	...	...	...	Hard and soft varieties. The soft assimilates with Orleans; the hard is best mixed with Brazilian.
	,, Soft Staple	...	...	...	...	
	,, Sea Island	...	...	...	...	Exotic.
	African	...	...	...	...	Harsh stapled cotton, not of a bright colour.
India	Surat	1·20	1·00	1·10	$\frac{1}{1185}$	The various classes under this head are fair working cottons; but the fibre is not so uniformly twisted as in Americans.
		1·20	0·80	1·00	,,	
	Bengal	1·30	1·00	1·15	$\frac{1}{1369}$	From Sea Islands and Egyptian seed.
	Rangoon	...	...	...	$\frac{1}{1185}$	Low in character, contains a large quantity of round and flat fibres.
	Madras	...	...	...	,,	

Cotton is valued according to the degree in which it possesses the special characteristics that best adapt it to the use for which it is intended.

the stack or to mix it in the scutcher, in which latter and more probable case with four laps up we should put two of each sort together, or three of Texas to one of Hinghunghat. The two cottons are pretty much alike in colour, being in each case of a light brownish tint. Hinghunghat, however, appears to be very seldom found in Liverpool.

Q. 1900. What cottons would you mix or use to spin (*a*) a cheap, soft weft to be used in cloth for raised goods; (*b*) a good quality of ring warp yarn, strong and moderately cheap, of 28's counts; (*c*) a moderately coloured 40's weft of good quality? State your reasons.

A. (*a*) Cheap, soft wefts to be used in cloth for raised goods, such as flannelettes, are often spun from cotton waste. Sometimes a little of the poorest of American, such as Mobile, may be mixed with the waste, or still more likely a quantity of Indian cotton, such as Dhollerah or Comptah, or all cotton may be used without waste.

(*b*) A good quality of ring warp yarn, strong and moderately cheap, could be spun from Texas or Orleans, of about 28's counts.

(*c*) A really high-class quality of 40's could be spun from brown Egyptian, while a fairly good quality could be spun from Texas cotton, using double roving at the spinning machine.

Q. 1896. Can you mix the following cottons? If not, why not? Uplands and Broach, Brown Egyptian and Orleans, Pernams and Mobile.

A. Uplands cotton is of the typical American kind, and forms an important division of our supply from that source, being much used for weft below 40's. (1) Broach is an Indian cotton, and also much in favour for wefts slightly lower than Uplands. Broach and Uplands have many features in common, and for some yarns may be mixed to advantage, but there is a difference of colour between the two, which is a serious obstacle to their blending in some cases. Uplands has a white or light creamy tint, whereas Broach is a brownish golden colour. (2) Brown Egyptian cotton differs from Orleans in several important particulars, which render it inadvisable to mix them. There is a great difference in colour and also in length of staple, and it is safe to say they are seldom, if ever, blended together. (3)

Pernams is a longer stapled cotton than Mobile, and is also of a harsh, wiry nature, whereas Mobile is notably soft, and both these conditions are opposed to satisfactory mixing.

Q. 1901. A mixture of cotton is required. You have the choice of two cottons, A and B. A costs $5\frac{5}{8}$d. and B $4\frac{3}{8}$d. per lb. They are to be mixed in the proportion of two of A to one of B. What would be the total cost of 32,000 lb. of such a mixture, and the cost per lb.?

A. 2 lb. of A at $5\frac{5}{8}$d. cost $11\frac{1}{4}$d.
1 lb. „ B „ $4\frac{3}{8}$d. „ $4\frac{3}{8}$d.

Cost of 3 lb. of mixture = $15\frac{5}{8}$d. = 15·625d.
∴ „ 1 lb. „ = $5{\cdot}208\dot{3}$d.

5·2083
32000

104166000
156249

12)166665·6 pence

20) 13888 + $9\frac{1}{2}$

694 + 8
= £694 8s. $9\frac{1}{2}$d.

COTTON BALING.

Q. 1900. Attempts are being made to introduce new methods of packing cotton for transport. State fully what you know of these, and the advantages claimed, together with any reasons for making the change.

A. Except perhaps in the matter of making heavier and harder pressed bales, there has been little alteration in the baling of cotton for a great number of years. For several years now great attention has been given to this subject, and various people have placed improved forms of bale on the market. Hitherto they appear to have received only a moderate amount of adoption. These improved bales mostly take the form of round lap bales, and it has been claimed for them: (1) A great saving of freight; (2) saving in storage room; (3) less danger of fire, and consequent reduction of insurance charges; (4) no hoops or metal of any kind about the bale, thus reducing risk of fire in the scutching-rooms; (5) easier handling of the bales; (6) cotton better covered up; (7) less loss of cotton in transit and in the opening and cleaning processes; (8) can be placed on the lattices of the first machines in the mill and unrolled mechanically like the ordinary scutcher laps, and mixing of cotton of different qualities can thus be done at this stage. In one case the round lap bales are made to weigh 260 lb., with each yard of lap to weigh 2 lb. Such bales are shown in Fig. 8, while an Egyptian bale is shown in Fig. 9, the latter being usually well made up.

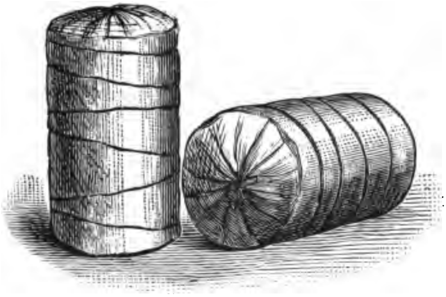

FIG. 8.

The advantages above claimed do not so far work out in practice as nicely as they are above stated. Many of the laps have refused to unroll satisfactorily, and in some trials the carders have experienced great difficulty in getting a satisfactory individual separation of the fibres. On the other hand, in many later trials the round lap bales have come off very well. In principle these round lap bales appear to be the proper thing, and it is quite possible that they may eventually receive large adoption.

The new methods of baling have been practically confined to American cotton, and there is no doubt that bad baling of this cotton has led to new devices.

Q. 1899. What do you know about the methods of packing cotton for export at present in use? What are the defects which usually exist, and what subsequent difficulties are produced by imperfect or excessive packing?

A. It is customary to make ginned cotton up into heavy rectangular bales, convenient for transport. According to the best authorities steam presses are most used in America, while in Egypt and India preference is given to the use of powerful hydraulic presses. As a rule the heaviest bales are Egyptian, averaging over 700 lb. each, and bound round by eleven steel bands. American bales vary considerably in weight, but may average about 480 lb., being bound round by about half a dozen iron bands. South American bales may only average less than half the weight of the ordinary American; while Sea Islands may be lighter still, in consequence of simply making up into bags for fear of damaging the fibre. A great outcry has been made about

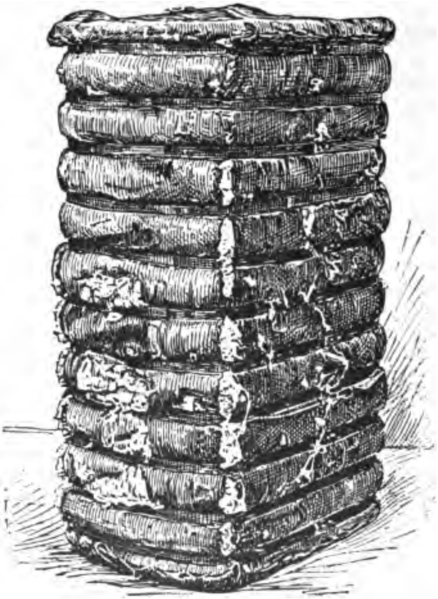

FIG. 9.—Egyptian Bale.

the unsatisfactory covering up of the American bales, it being alleged that the cotton has thereby suffered considerably during transit; while the danger of fire has also been increased. As a consequence great efforts are being put forth in some quarters to produce a heavy cylindrical bale. It has been considered by some that excessive pressure put on the fibres in baling injures them, but microscopical examination has not revealed such damage. As a matter of fact more pressure is put upon each individual fibre in the drawing rollers of the various spinning machines than in any baling press.

Additional Remarks on Baling.

We may say there can be little doubt that the minds of both cotton spinners and cotton planters are open to suggestions for improved methods of baling American cotton. All concerned are open to admit the probability of the adoption of some better method of handling the vast cotton crops of the Southern States of the American Union. Since Eli Whitney invented the saw gin (about the year 1792) the present form of bale has been accepted with little alteration, excepting a gradual increase in weight. As a matter of fact some bales of American cotton of immense density and weight have at times been tried, and microscopical examinations of the heavily pressed fibres have failed to detect damage from the heavy pressure. It is somewhat curious that America should be apparently behind Egypt in the matter of baling, although in quantity the American cotton crop quite overshadows the cotton crop of Egypt.

It has been said that no commodity of equal importance has received such ill-usage in the matter of handling as American cotton, and many consider the present rectangular bale to be wasteful and very irregular in the size of package. While not allowing many of the advantages claimed for the new bales, the present writer is quite prepared to admit that the present bagging and ties of American cotton afford insufficient protection from damage, theft and waste. Certainly the rectangular bale is somewhat clumsy to handle at each step of its progress from the ginnery to the mill.

Instead, however, of contending that these defects are very detrimental to the spinner, the present writer is more in accord with the following quotation from an American paper: "The cotton ginner may not perhaps realise the loss in weight and general wretched and ragged condition of his bale when it arrives at its destination in Europe, and the manufacturer knowing this from actual experience, makes the price after deducting this loss in weight and condition, and hence the producer is chargeable with all this waste and this extra high freight and insurance. It comes out of the price he should get at home for his cotton, and this is right, as no one is expected to pay for what he does not get, and hence if he expects to receive for full weight, he must take more care in his packing."

The Lowry bale is one of the new forms of bale that has received more or less adoption. In this bale the cotton is compressed to an average density of 47 lb. per cubic foot, which density is economical for loading either on land or sea.

With the rectangular bale it is often the practice to screw the bales into the hold of the vessel, and by this method the bales are very closely pressed, so that in unloading considerable force is expended in getting the bales out, this process resulting in the covering being torn, the marks being destroyed, and some of the cotton being wasted. Often the coverings have to be repaired before being sent on to the spinner.

The Lowry bale is named after the inventor of the press used to make it, Mr. George A. Lowry.

We can well understand that a system of baling which has been more or less in use for upwards of a century will not easily be replaced by any new method.

Weights.

One of the defects of the present system of baling cotton is the variation in the size and weight of the bales. While some bales of American cotton weigh upwards of 6 cwt., others weigh only about 3½ cwt. Taking extreme cases, bales have been found in the same large invoices varying from little more than 300 lb. to upwards of 650 lb. The following, for instance, have been given as being actual weights of bales from the same large invoice, the figures in each case representing the weight of a bale in pounds, and taking them in progressive form from the lowest weight to the highest: 336, 365, 381, 399, 406, 582, 584, 617, 629, 637. Bales as light as 300 lb., and others as heavy as 720 lb., have come to the same mill. In most deliveries, however, there is much greater uniformity than is indicated by the above figures.

Coverings.

Much of the bagging or sacking used to cover cotton bales is too open in the weave, and allows the cotton to get dirty and stained. This open weave also allows the different markings of the bales to penetrate to and discolour the cotton. Many of the bales are not fastened up properly, and are therefore soon broken open so as to expose the cotton to staining and pilfering. There can be no doubt that much improvement could be effected in these matters, even without introducing any new form of bale whatever. As a matter of fact, however, even if the tares or bagging be twice as good, it would still be liable to damage by the hooks and other implements used to haul the bales about. It is quite a fact that, while some portions of a bale may be so torn as to expose the cotton, other portions of the same bale are sometimes stuffed with thick pieces of tare with the apparent object of making the bales to weigh heavier. In England it is customary to allow 4 lb. per cwt. for tares, so that excessive weights of tares are against the spinner. Excessive weights of tares and hoops, however, probably represent a greater loss to the American than to the English spinner.

NEPPED COTTON.

Q. 1896. What is nep? In what stages in the production of cotton is it chiefly formed, and how?

A. Nep may be defined as the rolling up or entanglement of fibre into small white specks like grains of sand in magnitude. It may be either natural or artificial. As regards the former it may be said that in all cottons there is always some portion of fibre in what might be termed a green or raw state, even when the bulk of the cotton is fully ready for picking. These undeveloped fibres when the cotton is picked have a strong tendency to curl up, contract and entwine themselves amongst the good fibre in small white specks or nep. As regards artificial nep, this is produced to a greater or less extent in several of the earlier machines used in the making of cotton yarn. There is no doubt that ginning is responsible for a large amount of nep. The saw-gin so largely used in the Southern States of the American Union is notably guilty of making a large amount of nepped cotton owing to the saws being badly set and otherwise being out of order. Some of the more modern ginning machines are also far from being guiltless in the matter. Often the fibres are operated upon too long by the blades or saws of the ginning machines, with the natural result that neps are made. In the scutching room nep is often made by an excessive amount of beating, by the beater blades being out of order, and by sometimes trying to get too much work through one machine. The carding engine is often a fruitless source of nepped fibre by carding too heavy, by neglecting stripping and grinding and setting, by bad setting of the flats, rollers and clearers, doffer, doffer comb, etc. Also by sometimes allowing the web to become broken and to fill all the space up between the calender roller and the doffer until the cotton is carried round over the doffer and fills up the comb so that some portion of fibre remains some time subject to the action of the comb.

OTHER QUESTIONS ON COTTONS.

Q. What is Peeler's cotton?

A. From time to time planters in the Southern States of the American Union have tried to cultivate cottons which should be approximately equal to the average Egyptian cottons, although inferior to Sea Islands. Peeler's Orleans is a case in point which has been very successful. It has been grown from specially good seeds in the very favourable soil in the Mississippi bottom lands. It has been highly esteemed by velvet makers, but it is probable that the cultivation of these special varieties of American cotton is not on the increase, partly owing to the price and superiority of brown Egyptian.

Q. 1899. What are the principal causes for the short harsh nature of Indian cotton, and what are the differences between these, and the conditions under which Mississippi bottom land cotton is grown?

A. It may be taken that deficiency of moisture and excessive heat are the chief reasons why the cotton fibre as grown in India is so greatly inferior to American cotton. This is especially the case when the cotton-fields are far removed from waterways. In a great portion of India there is very little, if any, rain, this being largely dependent upon the monsoons. The soil, therefore, is necessarily dry and arid, so that both the soil and climate tend to give the poor qualities of fibre specified in the question. It may be added that carelessness in cultivation and ginning often make the cotton still worse.

In comparison with this it may be said that bottom land cotton is an exceptionally good grade of Orleans American cotton. It gets its name and special quality from being cultivated on low-lying soil, which is occasionally flooded and well fertilised by the Mississippi River. The climate is also exceptionally good, so that it has in full the very advantages which Indian cottons are short of.

Q. 1900. What are the commercial terms used to denominate the various grades of American, Brazilian and Egyptian cotton in the market, and what are the chief differences which enable the grade to be fixed?

A. When the syllabus of the City and Guilds examinations was revised in 1897 it was distinctly understood that points and details, more particularly belonging to the selection, classification and commerce of cottons, should be confined to the honours grade, and the latest official syllabus does not indicate any alteration from this. The fault of this and other questions in the ordinary grade is that they should have been in the honours. As regards American cotton, it is usually quoted at Liverpool for the following grades: Middling, fair, fully good middling, good middling, middling, low middling, good ordinary, ordinary. Brazilian cotton is graded as follows: Fine, good, good fair, fair, middling fair, middling. Egyptian cotton as follows: Extra fine, fine, good, fully good fair, good fair, fair, middling fair, middling. The following prefixes are used to the American cottons when required: "Strict" means half a grade higher, "fully" means a quarter grade higher, and "barely" means a quarter grade lower than the full grade. Doubtless many students in stating what points determine the grade would include such things as length, strength and fineness of fibre, but strictly speaking "grade" really means the appearance of the cotton as regards cleanliness and colour.

Q. Which makes the stronger yarn, rough or silky cotton? Give reasons.

A. Other things being equal, it may be taken that silky cotton would make a stronger yarn than rough cotton. The silky cotton would yield more readily to the processes of twisting, parallelising and attenuation of the fibres, and there would be fewer fibres projecting from the surface of the final thread than with the rough cotton.

Q. Where are Coconada and Nankeen cottons grown, and what counts are they suitable for?

A. These cottons are both of a high colour. Until recently it was considered that Nankeen cotton was always grown in China, but C. P. Brooks quotes a case of its cultivation in America. In any case, it is now seldom or never used in Europe or America. Except in colour it resembles the ordinary American cotton, and might be used for, say, about 30's. Coconada is an Indian cotton, which is used for low counts, say about 12's or 14's, and makes a good weft for some kinds of woven goods. It takes dye very well, but is not used to a very large extent.

Another high coloured cotton is red Peruvian, which, however, is of little commercial value.

GINNING OF COTTON.

Q. 1896. Describe the apparatus used by the Hindoos to free cotton from seed. What modern ginning machine most nearly approaches it in principle?

A. Next to ginning by hand, which is a slow operation indeed, the Hindoos used the foot-roller gin. This consisted of a slab of wood, stone or iron, upon which was placed the unginned cotton. An iron roller was worked about by the foot of the Hindoo upon the seed cotton until the fibre and the seed were separated more or less effectively. This operation was probably not a great deal better than hand ginning, and was superseded by the *churka*, or roller gin. This gin consisted of a pair of rollers fitted in a framework and operated by a handle fitted to the end of one of the rollers, while the latter were directly connected by a pair of rudely constructed wheels. The seed cotton being fed to the rollers, the fibres were torn from the seeds, and passed through the rollers, whilst the seeds fell to the ground, being precluded from passing through the rollers on account of their diameter. It speaks highly for this gin that its principle is preserved in some of the best gins of modern times. Both the Macarthy gin and the knife-roller gin closely resemble the *churka* in their principle of action. In each of the latter machines the chief difference is probably the application of the doctor knife, which is common to both. Whilst the seeds are held by their fibres between the doctor knife and the leather roller, they are rubbed until they are loose by the beater blade in the Macarthy gin, and by the knife roller in the knife-roller gin. The saw gin so extensively used for the ordinary staple of American cotton

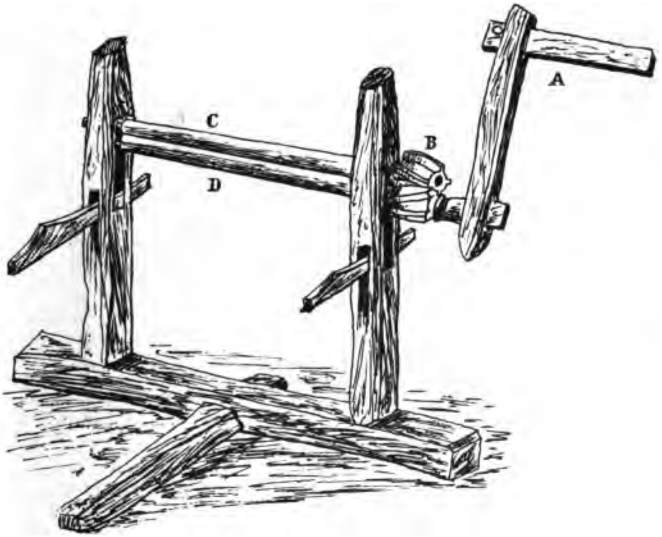

Fig. 10.—Churka Gin.

is totally unlike the *churka* of the Hindoos, both in principle and action.

Fig. 10 shows one form of *churka* gin. It simply consists of the two rollers, C, D, the rude wheels, B, and the handle, A, the whole sustained in a rough framework.

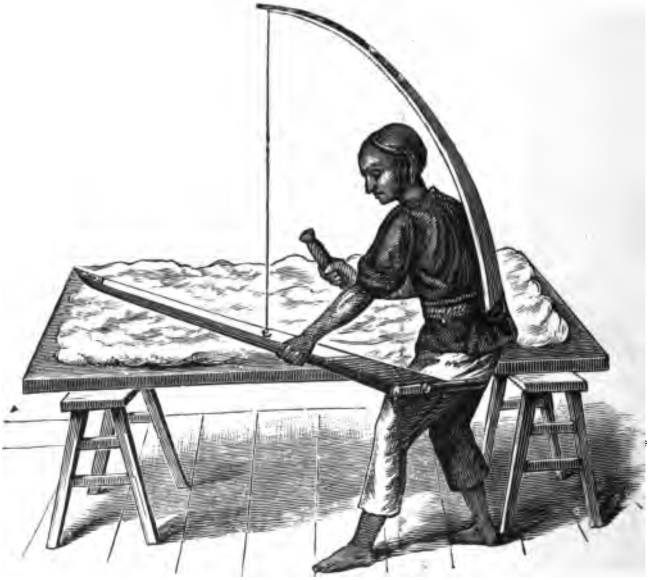

FIG. 11.—Bowing of Cotton as practised in India and China.

The Bow Gin.

Fig. 11 shows the Hindoo bow gin, and is taken from Dr. Ure, who says: "The man sits down, lays hold of it with his left hand, and holds a strong ebony club in his right hand. Thus equipped he strikes the string of the bow with his club so as to make it toss a flock of the foul cotton up into the air with great violence, and thus to discharge its impurities."

Q. 1896. Describe the differences existing in the construction and action of the two principal types of ginning machines. Say how far these differences affect the cotton in passing through the machine.

A. There are two principal types of gin, *viz.*, the roller gin and the saw gin.

The use of the saw gin is practically confined to the Southern States of the American Union, but since these States furnish us with more cotton than all the rest of the world put together, it follows that a great portion of the world's annual production of cotton passes through the saw gin. Its essential feature consists in having a varying number of quickly revolving circular saws threaded on a square shaft, and projecting through special bars, which keep the saws about five-eighths of an inch apart. In some cases there are upwards of sixty or more saws. The seed cotton is placed in a feed box, and, coming into contact with the projecting teeth of the saws, the latter try to carry it through the bars. The latter, however, are too close for the seeds to pass through, and therefore the fibres are plucked from the seeds and carried forward, while the seeds then fall through bars arranged for the purpose.

This form of gin is notably injurious to the cotton, cutting and nepping it to a great degree. This is so true that it is not used for any of the better classes of fibres such as Sea Islands and Egyptian. It is simple in construction and very productive.

The Macarthy gin is very widely adopted in various countries. Instead of having saws to carry the cotton forward, the latter is carried along from the feed bars by a quickly revolving leather-covered roller. Pressing against the leather roller is a steel blade termed the doctor knife, which prevents the seeds from being carried forward by the roller. While the seed cotton is held by the doctor knife and the leather roller it is rubbed against or struck by a reciprocating beater blade, oscillating on a fixed centre, the motion being got from a crank shaft. In a double action Macarthy there are two blades acting alternately, while in a single action Macarthy there is only one blade. The seeds being loosened by this action, drop through suitable bars, while the leather roller carries the fibres forward. The roller gin in one form or another can be used for any class of cotton; but it is not quite so simple as the saw gin. It is made by quite a number of firms.

The knife roller gin is a modification of the Macarthy, in which the beater blades are displaced by a roller built up of peculiarly shaped circular knives, which rub against the seeds laterally, whereas in the Macarthy the rubbing action is upwards and downwards.

Saw Gin.

Fig. 12 is a longitudinal section of the saw gin. A is the saw roller, and there may be as many as sixty or more steel circular saws threaded on the same shaft; B is the revolving brush; C is the passage of the cotton from the saws and brush to the condensing arrangement, D, E; G is the feed table for the unginned cotton; H is a conducting roller for the cotton; and I indicates the unginned cotton itself.

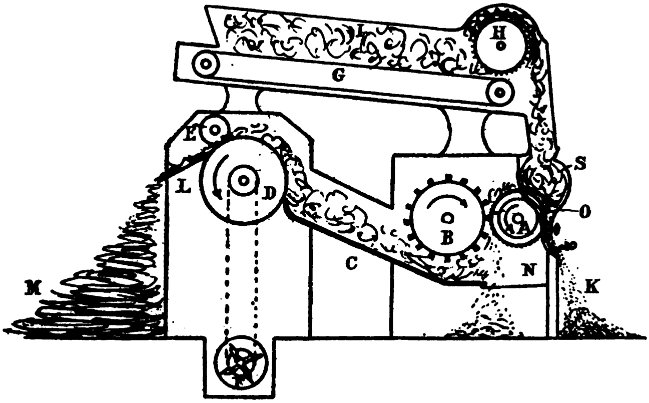

FIG. 12.

The seed cotton being delivered to circular saws, A, the sharp teeth of the saws pull the fibres through the grid, O. The saws are kept a short distance apart by washers. The thin bars of the grid pass between the saws. The bars have to be sufficiently close to each other to prevent the seeds from passing through, and the latter, therefore, being parted from the fibres, fall down in front of the grid at K. It is possible that some impurities may pass through the grid at N. The lint or cleaned cotton is then placed upon the condensing

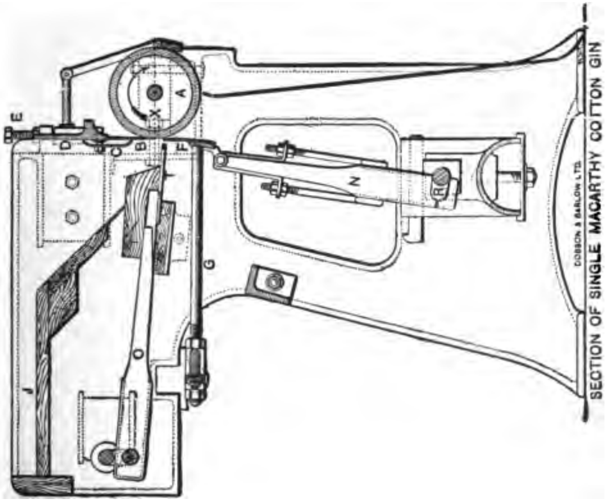

FIG. 13.

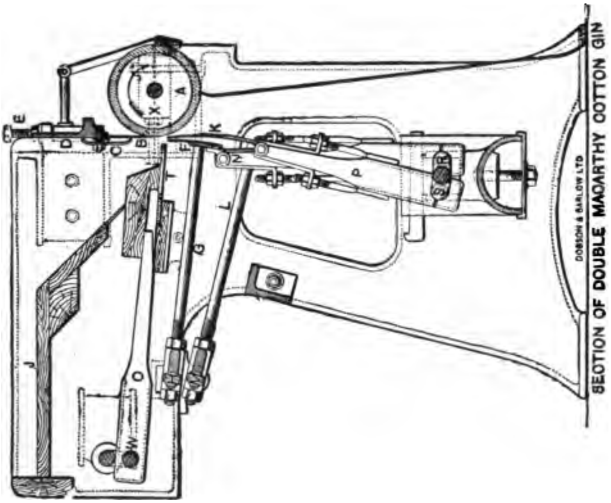

FIG. 13 (*a*).

rollers, D, E, much after the manner of the placing of the cotton in a scutcher upon the cages. After delivery from rollers, D, E, the cotton may be disposed of in different ways, the method shown in Fig. 12 being to simply deliver it over the plate, L, and upon the floor as at M.

Macarthy gins, as made by Messrs. Dobson & Barlow, are shown in Figs. 13 and 13 (*a*).

SINGLE-ACTION GIN.

A	Leather Roller.
B	Doctor Knife.
C	Springs.
D	Doctor Knife Rail.
E	Adjusting Screw for Knife Rail.
F	Beater Knife.
G	,, ,, Bar.
H	,, ,, ,, Centre.
J	Feed Table.
N	Connecting Rod for Beater Knife.
O	Feeder Bar.
R	Crank for moving Beater Knife.
T	Grid.
W	Crank for Feeder Bar.
X	Adjusting Screw for Leather Roller.

DOUBLE-ACTION GIN.

A	Leather Roller.
B	Doctor Knife.
C	Springs.
D	Doctor Knife Rail.
E	Adjusting Screw for Knife Rail.
F	Upper Beater Knife.
G	,, ,, ,, Bar.
H	,, ,, ,, Bar Centre.
J	Feed Table.
K	Lower Beater Knife.
L	,, ,, ,, Bar.
M	,, ,, ,, Bar Centre.
N	Connecting Rod for Upper Beater Knife.
O	Feeder Bar.
P	Connecting Rod for Lower Beater Knife.
R	Crank for moving Upper Beater Knife.
S	Crank for moving Lower Beater Knife.
T	Grid.
W	Crank for Feeder Bar.
X	Adjusting Screw for Leather Roller.

Directions for Setting.

Set the machines level on a firm floor and parallel with the driving shaft.

See that the speeds are right.

Set the bevelled edge of the doctor knife against the leather roller, so that the edge of the knife may be in a line with the centre of the leather roller.

Set the beater knife, F, in single-action gin, and the knife, K, in double-action gin, by means of the nuts on the beater

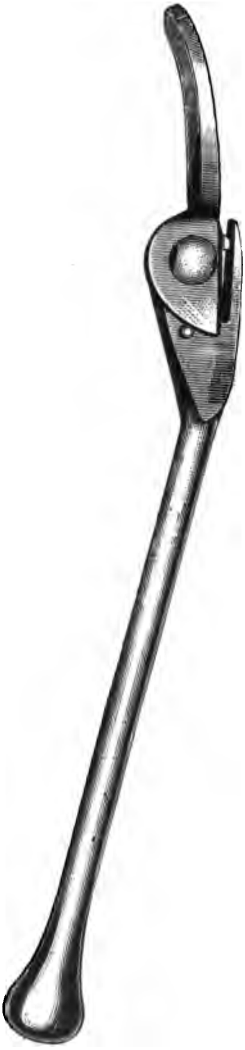

FIG. 14.—The Lightning Tie Cutter for Cotton Bales.

knife bars, to about $\frac{1}{32}$ in. from the doctor knife when passing it.

When ginning short-stapled cotton the beater knife, F, in single-action gin, and the knife, K, in double-action gin, should overlap the doctor knife $\frac{3}{8}$ in.; but for long-stapled cotton $\frac{1}{2}$ to $\frac{5}{8}$ in. is the usual overlap.

The feeder bar can be adjusted, as to its travel, according to the size of the seeds.

See that the grid is so adjusted that the seeds fall freely through it.

The Kitson Machine Company manufacture the cotton tie cutter represented in Fig. 14.

The cutter consists of but two parts, bolted securely together. The first, about 18 inches long, furnishes ample leverage and supplies one blade of the cutting shears. The other, 6 inches in length, supplies the chief cutting blade, and projects far enough along the surface of the bale to hold the knife firmly. Both parts are forged steel, hardened and tempered.

The operation is simple and quick, and requires but light labour. The tongue, shown at the bottom of the cut, is inserted beneath the tie, and then a pull upon the long lever presses the tie against the upper cutting blade and severs it instantly. The knife is readily sharpened after the bolt has been removed.

It should be remarked that with this implement it is possible to cut the tie at the exact point desired, however near the buckle. There is no danger of sparks or of bits of tie getting into the cotton. Moreover, the cutter can be operated within very small space, a play of a few inches being all that is required.

In England at any rate the usual method of breaking the bands off the cotton bales is by means of an axe, and this has been the common practice for a great number of years.

CHAPTER II.

BALE-BREAKERS, MIXING LATTICES AND HOPPER FEEDERS.

BALE-BREAKERS.

Q. The bale-opener is a new machine recently introduced. Describe it, and say in what respect its use is advantageous.

A. It has always been the practice to give the raw cotton a preliminary pulling into pieces of comparatively small size before making the mixing of cotton or passing the latter through the opening machine. Until the last few years this work was always done by hand, this practice being still retained in some mills using only a small quantity of cotton. At best, however, this operation is very slow, and is often done in a careless manner. Large pieces of cotton have often been thrown on the mixing and have got into the opener so as to cause bars to be broken and the opening to be very indifferently performed. To avoid these evils great care has to be exercised by the attendant entrusted with feeding the opener.

Recently, however, the vast majority of mills have adopted one form or other of "bale-breaker" or "cotton-puller," which does the work far better than it was usually done by hand, while at the same time being exceedingly productive.

Fig. 15 is a general view of the bale-breaker as made by one machinist, while Fig. 16 shows how the rollers work in with each other as made by another firm.

The most usual form of bale-breaker—as made by several of our machinists—contains four pairs of coarsely fluted or spiked rollers, having a certain amount of draft, the top rollers being held down by strong spiral springs or by dead weights.

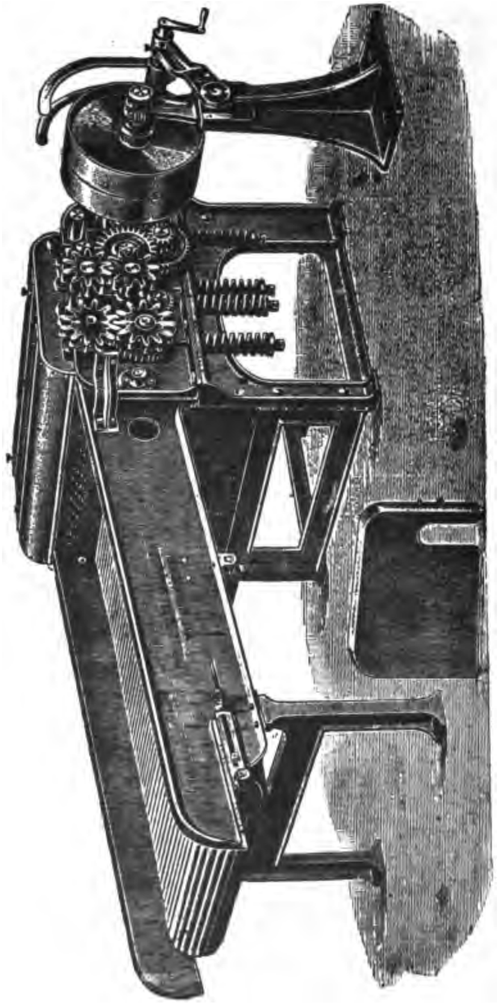

FIG. 15.

Several bales of cotton, representing the different sorts to be mixed together, are placed adjacent to the feed lattice, and, according to some definite system, portions of cotton from the different bales in succession are placed on the lattice. The cotton is thus delivered to the first pair of rollers, the term "collecting rollers" being sometimes applied to this pair. Each pair of rollers the cotton comes to revolves faster than the preceding pair, and in this way the cotton is

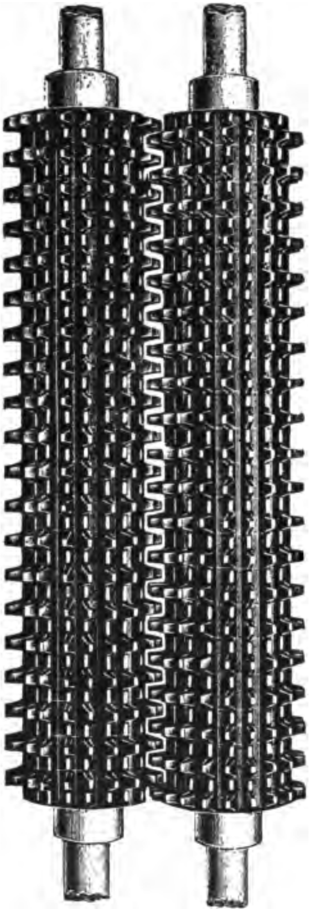

FIG. 16.—Position of Rollers.

pulled into pieces of convenient size for feeding to the opener. Working speeds might be something like as follows:—

1st	pair	of rollers	6	revolutions	per minute.
2nd	,,	,,	15	,,	,,
3rd	,,	,,	60	,,	,,
4th	,,	,,	300	,,	,,

Taking the rollers as being of equal diameter, which is the most usual practice, we thus get drafts as follows:—

Between 1st and 2nd pairs . . $\frac{15}{6} = 2{\cdot}5$ draft.
,, 2nd and 3rd ,, . . . $\frac{60}{15} = 4$,,
,, 3rd and 4th ,, . . . $\frac{300}{60} = 5$,,

The total draft therefore would be:—

$$2{\cdot}5 \times 4 \times 5 = 50 \text{ draft.}$$

Probably in most cases the draft is somewhere between 30 and 40, but the cotton never actually pulls out to the calculated draft on a bale-breaker.

Opener Bale-Breaker.

In some cases, especially for low cottons, what is termed the opener bale-breaker has been used. In this case there are only two pairs of rollers, and these give the cotton to a small porcupine cylindrical beater. The cotton is in this way beaten down upon beater bars and a fair amount of cleaning is secured, and more thorough opening than with the four pairs of rollers. It is probable that this machine treats the cotton more fully than is desirable before the mixings are made, and its production is limited.

Pedal Breaker.

This is another special arrangement, in which the first pair of rollers are dispensed with and their place taken by a coarsely fluted, top-ticing roller working over a number of pedals or levers. These are designed to give a closer grip to the cotton and to prevent sudden shocks and breakages of the roller spikes by allowing the pedals to give way.

Neither this machine nor the pedal bale-breaker appear to have received very much adoption.

MIXING LATTICES AND MIXING.[1]

Q. 1897. At what stages in the preparation of cotton for carding are different varieties mixed? Say what you know of the effect at each stage?

A. The two great stages at which cotton is mixed, prior to leaving the card, are at the mixing and at the scutcher. The great bulk of mixing is done in the mixing-room. When the cotton-puller is used, bales of the various sorts and proportions are arranged conveniently to the feed lattice of this machine, and a portion of cotton from each bale in succession is placed thereon, so that in passing through the machine, and in being distributed on the mixing, they get pretty well blended together. If the cottons, however, differ considerably in regard to the amount of dirt they contain, colour, etc., it is best to pass them through the bale-breaker separately, and to make separate mixings of them, and to pass them also separately through the openers. Afterwards the laps may be put up in any required proportion at the scutcher.

Q. 1898. What is the advantage derived from breaking up cotton as it is received in the bale and letting it remain in the sack for some time? How far does this aid in the subsequent operation of opening?

A. Cotton as received in the bale is always more or less matted together, owing to the heavy pressure put upon it in the process of forming the bale. Consequently it has always been found necessary to pull or break it into pieces of comparatively small size before feeding to the opening machine. This was formerly always done by hand, and in some cases it is yet pulled manually. By making large stacks of cotton greater uniformity in the yarn is secured.

Most spinning firms now, however, employ the bale-breaker or cotton-puller, which does the work much more quickly and effectively. This preparatory pulling enables the opener to do its work of cleaning and opening much more readily and effectively. In addition to this, if cotton remains in a stack for some time after passing through a bale-breaker, the fibres tend to become more supple and loose, and are more readily separated in the subsequent processes. It is probable that the very general application of hopper feeds to openers has rendered the use of bale-breakers still more necessary.

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[1] For notes on the mixing of cotton the reader is referred to previous pages of this work.

Q. 1898. Describe briefly the modern mixing-room, name the machines used, and give a sketch showing the way in which they are arranged to mix and distribute the cotton.

A. The machines used in a modern mixing-room are the bale-breaker or cotton-puller and the mixing lattices. An excellent and largely adopted method may be as follows: A bale-breaker, with four pairs of coarsely fluted or spiked rollers, arranged with a total draft of something like 35. The cotton from this machine is taken upwards by a compound or double lattice, and delivered upon a horizontal lattice, which may deposit the cotton upon a second and similarly disposed lattice, or may at once drop the cotton upon the mixing, or yet again it may deliver the cotton upon a transverse lattice to feed either one of two mixings. If the second long lattice receives the cotton from the first, it may deliver the cotton either upon the mixing or upon the second transverse lattice, which feeds either a third or fourth mixing at pleasure. The lattices can be reversed in direction of movements very easily, in order to facilitate the placing of the cotton wherever required. With two long lattices and two transverse lattices four distinct mixings can be made, but these lattices can be arranged to feed any required number of mixings. Occasionally the feed portion of the opener may also be placed in the mixing-room. Sometimes also the same large room is made to serve as a bale-room as well as mixing-room, in which case it may possess a specially made hoist or crane for winding the bales from the lurries into the room. Figs. 17 to 20 are reproduced by the kindness of Messrs. Platt Bros. of Oldham.

Fig. 17 shows an arrangement with the bale-room over the mixing-room.

The cotton being taken from the bales at A is passed through the bale-breaker, and then drops through the floor at C to the mixing lattices. In this case there are three mixing lattices, with which it is capable of making four different mixings of cotton, as shown. The sketch shows the cotton passing to No. 4 mixing, but by reversing the direction of motion of the lattices any one of the four mixings

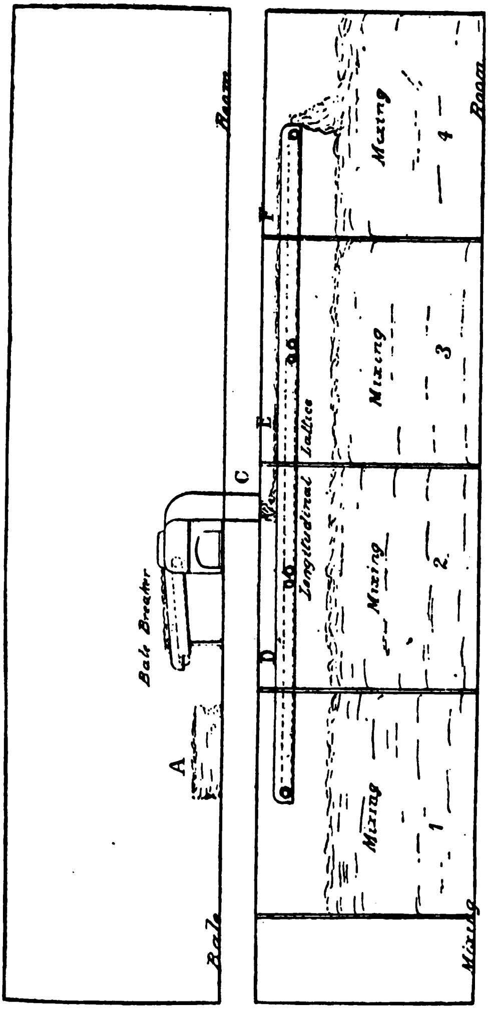

Bale Room
Bale Breaker
A
C
D
E
F
Longitudinal Lattice
Mixing 1
Mixing 2
Mixing 3
Mixing 4
Mixing Room

FIG. 17.

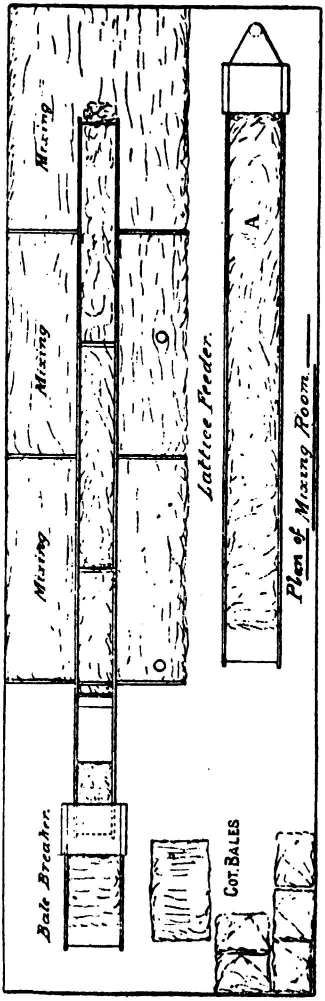

Mixing
Mixing
Mixing
Lattice Feeder.
A
Plan of Mixing Room.
Bale Breaker.
Cot. Bales

FIG. 18.

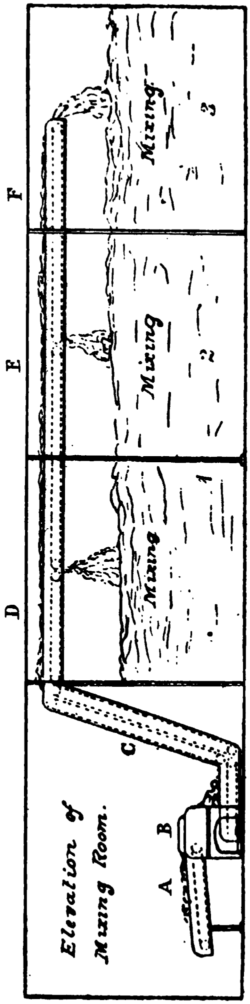

Elevation of Mixing Room.
A
B
C
D
E
F
Mixing
Mixing
Mixing
1
2
3

FIG. 19.

can be made. The reversing can be performed by any one in a moment.

Figs. 18 and 19 show an arrangement with the bales of cotton and the mixings in the same room. The cotton being fed on lattice A, is carried upwards between the *double* lifting lattice C, and then deposited by the lattices D, E, F, on any one of the three mixings, 1, 2, 3.

Fig. 18 is a plan of the arrangement and Fig. 19 an elevation.

Very frequently transverse lattices are arranged underneath the longitudinal ones shown, so that the cotton is carried crosswise to other positions for the mixings.

Fig. 20 shows an arrangement sometimes used when the mixing and bale rooms are at some distance apart.

HOPPER BALE-BREAKER.

It is well known that an ordinary bale-breaker is an exceedingly productive machine, it being quite possible with one of the strongest and widest machines to pull upwards of 100,000 lb. of cotton per week of 56½ hours.

Cases actually exist to the writer's knowledge where upwards of 70,000 lb. weight of cotton are pulled weekly by one of those machines with four pairs of rollers.

In view of this statement one would have thought inventors would never have thought of displacing this bale-breaker with a machine of a totally different character, although constant endeavours have been made to introduce inprovements in detail.

Quite recently, however, a new machine has been adopted as a bale-breaker or cotton-puller, which bids fair to displace in time the familiar roller bale-breaker. The new machine is simply an adaptation of the now well-known hopper feed for openers, as a machine to treat the cotton taken directly from the bale. There is really little or no real invention at all in regard to this matter, the principal point being in conceiving or realising that the hopper feeder would be able to perform such work in a very efficient manner and without excessive breakdown.

Quite recently the author inspected one of these hopper bale-breakers while in actual work in one of our Bolton cotton mills. A bale of Egyptian cotton was put through the machine in four minutes, the weight of cotton being about 7

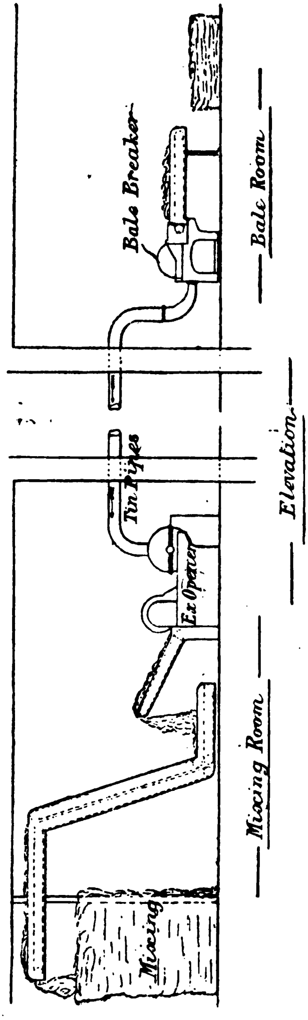

Bale Breaker
Bale Room
Tin Pipes
Ex Opener
Elevation
Mixing Room
Mixing

FIG. 20.

cwt. According to this, if it were possible to keep the machine going to the above capacity, it would be capable of pulling upwards of 500,000 lb. of Egyptian cotton in a week.

The cotton appeared to be quite sufficiently well pulled, and fully equal in this respect to the work done by the ordinary machine.

The machine was almost noiseless, in this respect being much superior to the bale-breaker with four pairs of rollers.

In the latter machine a certain degree of care is necessary in spreading the cotton on the lattice, or the machine would choke and the rollers stop.

In the new hopper bale-breaker pieces of cotton as large as two men can lift are tumbled into the feed-box and practically taken no further notice of. The adoption of this machine will almost eliminate the wages paid for opening the cotton in mills that do not consume a very large quantity of cotton, as the work may be done by some of the work-people putting in a little overtime.

It is rather a curious fact that it appears to require almost twice as long for one of these new machines to open 500 lb. of American cotton as it does to open 750 lb. of Egyptian cotton.

The explanation appears to be due to the softer and more clinging nature of the American cotton resisting the pulling and opening action of the machine.

The machine itself consists of a horizontal lattice at the bottom of the feed-box, an inclined lifting lattice of greatly strengthened construction, equalising and stripping rollers. It is used in conjunction with the usual mixing lattices. In some cases a fan pipe is coupled up to draw away the dust out of the cotton.

Dobson & Barlow's Hopper Bale-Breaker.

The principal features of this machine are shown in the accompanying illustration (Fig. 21), which is a side view in section. The cotton is fed into the hopper, A, by hand, direct from the bale, and the feed lattice, with its aptitude to clog or get out of order, is avoided. The bottom of the hopper consists of a grid, F, which allows all dust and loose dirt on the surface of the lumps of cotton to fall through into the dust chamber below. The cotton is taken from the

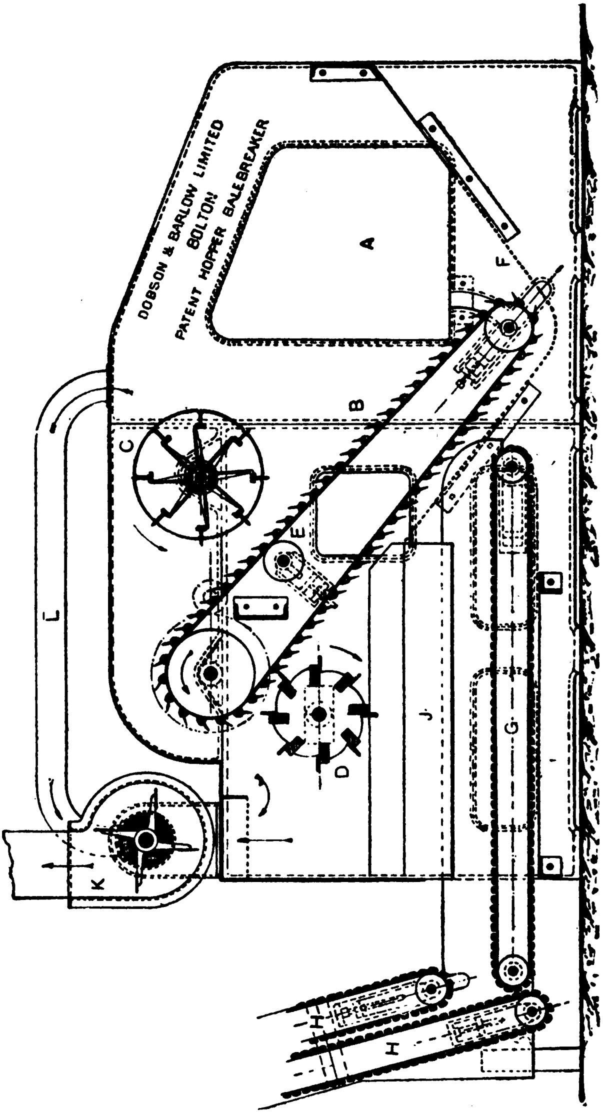


FIG. 21.—Improved Hopper Bale-Breaker.

hopper by the spiked lattice, B, which travels at the rate of 200 feet per minute, the amount being regulated by an evener roller, C, having eight rows of teeth, made of hardened steel and mounted eccentrically on the evener roller shaft in the usual way.

The evener roller makes from 60 to 70 revolutions per minute, and the cotton which it allows to pass is thrown off by the leather flap roller, D, which has a speed of from 400 to 500 revolutions per minute. All the driving is arranged from one shelf, the bearings are all either cast-iron or hardened steel into cast-iron, and special arrangements are made for easily adjusting the rollers and lattices in relation to each other. The cotton, when thrown off the spiked lattice by the flap roller, may be arranged so as to fall through the floor into the room below; if required in the same room, it falls on to a travelling lattice, H, which carries it to its destination.

One very important feature is the arrangement for carrying away the dust. A fan, K, is placed on the top of the machine, and, by pipes placed just over the flap roller and over the evener roller, draws away the particles of dust and fluff which are always present in large quantities in this class of machine. The entrance to each pipe is protected by a grid or perforated box chamber, which prevents the fibre being drawn away with the dust. It is needless to remark that this arrangement makes a difference to the breaker-room. The air is purer, the machinery is kept cleaner, and the cotton is in a cleaner state when passed on to the opener or scutcher. The output is very satisfactory. An American bale can be put through in from six to twelve minutes when fed by one attendant. An Egyptian bale can be opened in from three to five minutes, but requires two feeders to keep pace with the machine.

Round Bale Opening Machine.

The vast improvements and alterations which have been made in the earlier processes of a cotton mill during the last couple of decades do not appear to have even yet exhausted the capabilities of inventors in this direction. A mixing-room was formerly a very simple affair indeed, containing no machinery or apparatus excepting possibly a pair of scales with which to weigh the cotton and a crane to wind the cotton bales up. Even these would probably be in the bale-room in cases where the two rooms were distinct. Now it is a somewhat costly matter to fit up a mixing-room on the most modern principles. It needs a bale-breaker and mixing lattices, which help to make the mixing-room almost like a blow-room. In the blow-room itself we have now the hopper feed, which, during the last few years, has received very extensive adoption.

We have previously referred to the new round bales and the new hopper bale-breaker, which are both now more or less occupying the attention of practical spinners and machine makers. Accompanying the possible adoption of the new round lap bale there must be specially arranged opening machines. Of these the firm of Messrs. Howard & Bullough, of Accrington, have designed a machine designated the round bale opening machine. It is on the lines of the usual porcupine opener, but arranged with a set of draft rollers where the cotton enters, in order that the lap thickness may be sufficiently reduced and the fibres somewhat loosened before the cotton reaches the beater. The round bales are placed in a lattice, and rotate on rods after the style of scutcher laps. Necessarily the lattice and the rollers have to be specially strong in order to take laps weighing 260 lb. The success of such a machine as this will be attendant only upon the adoption of the round bale. Other parts of the machine are pretty much after the usual style we are familiar with. The author is not aware of any of these machines being yet at work.

THE HOPPER FEED.

Q. 1896. What is the hopper feeding machine? Select any make of machine with which you are familiar, saying which it is, and state the functions of the various parts.

A. The hopper feed is one of the most recent improvements of magnitude successfully adopted in connection with cotton spinning machinery. It is a labour-saving contrivance, inasmuch as it performs automatically work that was previously performed by hand. Frequently during the last few years one attendant has become able to feed two openers by the application of the hopper feed where previously two attendants were required, or one for each machine. In some cases even this has been exceeded. Also, it helps in a comparatively gentle manner to open the cotton, and in the most modern arrangements means are provided by which the feeder assists in making a regular lap. For some time, however, after the hopper feeders began to be adopted in England, very serious complaints were made that the machines to which they were attached produced uneven laps. The principles of these automatic feed arrangements are the same as constructed by the different machinists, but there are differences in detail. For this description we will choose the arrangement made by Messrs. Dobson & Barlow. In this machine the cotton instead of being thrown by the attendant into the feed-box or hopper is delivered thereto by a patented arrangement, which we will describe later on. Along the bottom of the feed-box is a lattice, which carries the cotton forward into the range of action of the teeth in a spiked lattice, which is set almost vertically, or say at an angle of from 15 to 20 degrees from the vertical. The lattices may be, if required, ranged at right angles to each other, the front part of the bottom lattice being inclined to the horizontal about as much as the chief lattice is inclined to the vertical, in order that the cotton can be stroked upwards more effectively. In front, and near the top of the upright lattice, is an equalising roller which strokes back any supercharge of cotton which may have been taken upwards by the lattice. In the same horizontal plane as the evener roller, but placed on the opposite side of the upright lattice, or behind it, is the stripping roller, which beats or strips the cotton from the chief lattice and passes it forward to the delivery rollers, which give the cotton to the opener lattice. Preceding the delivery roller is a single roller set over a pedal feed regulator, and the exit of the cotton is thus carefully regulated. The regulator consists of the ordinary upright cone box, with concave and convex cone drums of large diameter and anti-friction bowls. Beater bars are placed below the stripping roller in order that dirt may pass through.

The special patented method of delivering the cotton to the hopper or feed-box may now be described. The cotton

References to Simplex Hopper Feeder.

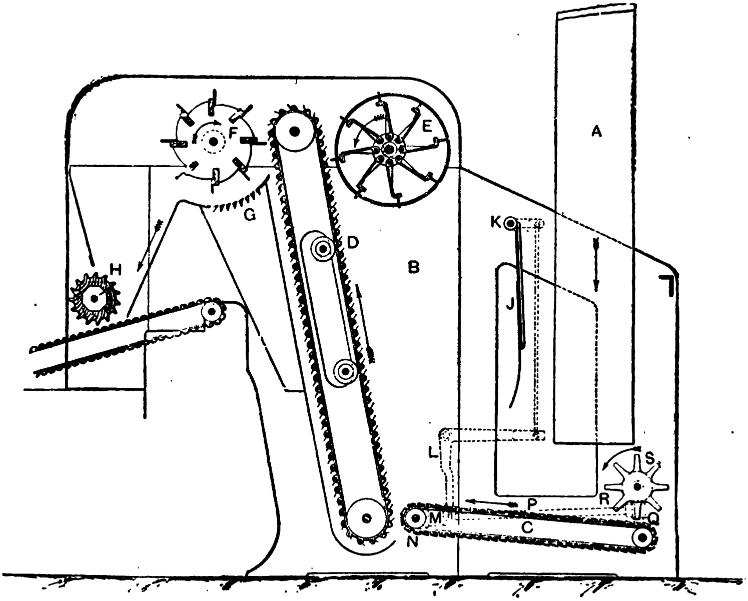


Fig. 22.

A	Feed Trunk.	K	Feeler Plate Rod.
B	Cotton Chamber.	L	Knocking-off Lever Pivot.
C	Bottom Lattice.	M	Catch Box.
D	Upright Spiked Lattice.	N	Bottom Lattice Driver.
E	Patent Evener Roller.	P	Side Shaft.
F	Stripper Roller.	Q	Worm.
G	Dust Bars.	R	Worm Wheel.
H	Condensing Roller.	S	Spiked Feed Roller.
J	Feeler Plate.		

Notes.

Power.—About 1½ i.h.p.

Pulleys and Speeds.—Stripper roller pulley, 12 in. diameter by 2½ in. wide, 225 revolutions per minute.

Evener roller pulley, 12 in. diameter by 2¼ in. wide, 80 to 120 revolutions per minute.

is placed in a trunk, which has its mouth in the room above the machine. At the lower part of the trunk, where it is turned into the back of the hopper, there is a shutter door, which is worked from mechanism in connection with the hopper. Across the framing of the feed-box is a rod, having on it feeler bars. These latter are pressed upon by the cotton in the hopper, and if the amount of cotton in the hopper becomes too great the feeler bars are moved, so that a catch box is put into gear, and the shutter door closed, so as to prevent any further delivery of cotton into the feed-box until it is required. When the cotton in the box gets below a certain quantity the feeler bars resume their former position, the shutter door is again opened, and a further feed of cotton is permitted. The object of this invention is to remedy a defect which it is well known that the earlier applications of hopper feeders contained. If too much cotton is in the hopper there is a tendency for the cotton to be taken forward thickly by the upright lattice, and if too little cotton is in the box there is a tendency to take the cotton forward too thinly. In this arrangement there are three important applications of mechanism for producing an even lap: (1) the shutter door, (2) the evener roller, (3) the pedal feed regulator. Many hopper feeders are at work with the above arrangements.

In later arrangements the cotton in the hopper is pressed by a continuous hinged door the width of the box instead of having individual feeler bars. The pressing back of the door by the cotton stops the feed of cotton. A friction clutch may be used instead of a box clutch to drive the feed parts. It is usual now to employ a spiked roller, S (Fig. 22), at the bottom of the feed trunk to assist in regulating the feed of cotton.

Fig. 22 shows Dobson's hopper feeder with the most recent modifications. There is a spiked roller, S, instead of the shutter door. The condensing roller, H, gives the cotton to the opener feed-lattice.

Howard & Bullough's Hopper Feeder.

While the main features and principles of all makes of hopper feeder are the same in all cases, there are naturally differences of detail.

Fig. 23 shows a hopper as made by Messrs. Howard & Bullough. A is the feed-box; B, the bottom creeper; C, the lifting lattice; D, the equalising roller; E is a special roller designed to assist the cotton forward and to break up the cotton; F, the stripper roller; G, the dirt bars, over which

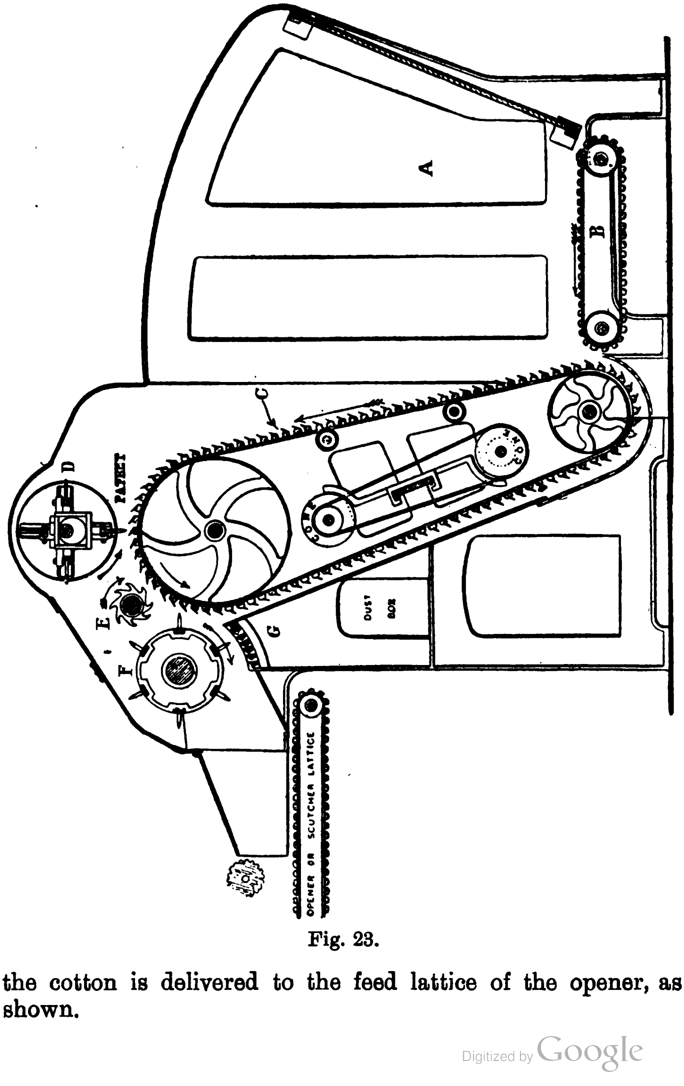


Fig. 23.

the cotton is delivered to the feed lattice of the opener, as shown.

A noteworthy feature of this hopper is the position of the evener roller, D, it being fixed over the top of the lifting lattice. The steel pins are formed and acted on by an eccentric, so that they are projected when opposite the lifting lattice and withdrawn when turned away therefrom, in order to clean the pins.

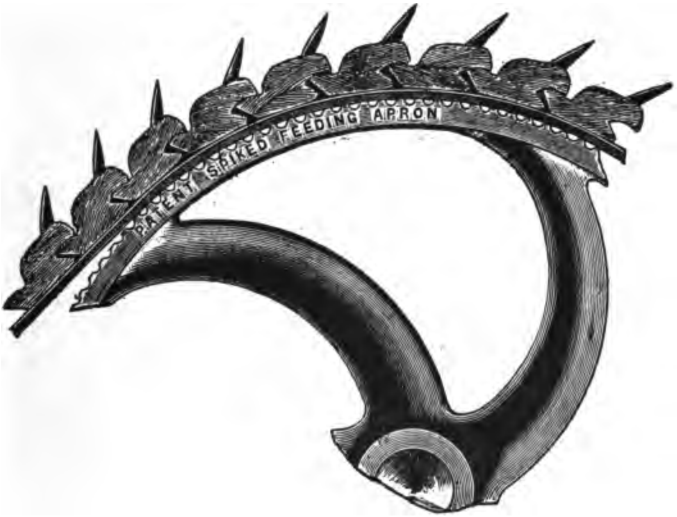


Fig. 24.

Fig. 24 shows an improved and very strong form of lifting lattice, of especial value in the new hopper bale-breakers.

Note.—In Vol. III. of this series, illustrations and descriptions of Lord Bros.' hopper feeder will be found.

CHAPTER III.

OPENING AND SCUTCHING.

Q. 1898. Give a statement of the objects aimed at in the operation of opening, and describe fully the treatment of the cotton to affect them.

A. This process first opens out the matted masses of fibres to a very fleecy, soft condition; secondly, it extracts the major portion of the impurities present in the cotton, such as leaf, sand, etc., and also much seed that has escaped the ginning process; thirdly, it almost now always makes a lap. To effect these operations the cotton is now usually placed in a hopper or feed-box, which places the cotton uniformly upon a feed apron. This latter carries the cotton forward in such a manner that the cotton is fed by one means or other to a large, powerful and quickly revolving beater, which subjects the cotton to an enormous amount of knocking about, so as to open it out to a considerable degree. Placed in close juxtaposition to the beater is an iron grid, against which the cotton is dashed, and through the interstices of which a considerable proportion of the impurities pass into a suitable receptacle. From this beater the cotton is taken away, partially under the influence of an air current induced by a powerful fan, and usually made into a lap in a manner to be described in answering questions treated later.

Q. 1898. What is the distinctive feature in the construction of an exhaust opener, and why is it so named? Say what you know about the action of the fans in exhausting and delivering the cotton properly.

A. The distinctive feature of an exhaust opener is the employment of a long tube or trunk, through which the cotton is carried under the influence of an air current before reaching the large beater. The term has been most frequently applied to the openers in which this long feed trunk has been combined with a horizontal conical beater, as introduced many years ago by Messrs. Lord Bros., of Todmorden. We see no reason, however, why the term should not be just as applicable to an opener in which the vertical conical beater, or the horizontal porcupine beater, is combined with the long feed trunk. It is evident the term has been applied because the cotton is carried along the feed trunk by the air being first partially exhausted from the trunk. Quickly revolving fans used in conjunction with slowly revolving cages or sieve cylinders may, perhaps, be said to constitute the most distinctive feature about the blowing-room machinery as distinguished from any of the subsequent processes. Revolving perhaps 1,100 times per minute, the fan creates a partial vacuum in the machine by blowing the air through certain exit chimneys and trunks. The air thus exhausted from the machine leaves a partial vacuum, which can practically be only filled by air which is allowed to enter at the feed portion of the machine, and the inrushing air takes the cotton along with it and deposits it upon the perforated cages. In the case of the exhaust opener, the cotton is first passed through what may be termed a small opener or bale breaker, which breaks the cotton up to some extent and delivers it to the feed trunk. Along this trunk, therefore, the cotton is now carried by the air current induced by the powerful fan placed at the other end of the trunk. There are cases in which the cotton is thus carried through exhaust trunks for 100 yards or more, being dried and, to some extent, cleaned in its passage.

It is important to note the feeder in the case of these exhaust trunks can either be (1) in the room above as shown; (2) in the same room or on the same level; (3) in the room below.

Fig. 25 shows the feed of an exhaust opener, as made by Messrs. Howard & Bullough.

The cotton is fed from the mixings into the hopper at A, and thence passes through the grated trunks or pipes at B, and through the floor, C, down the pipe to the large beater of the opener.

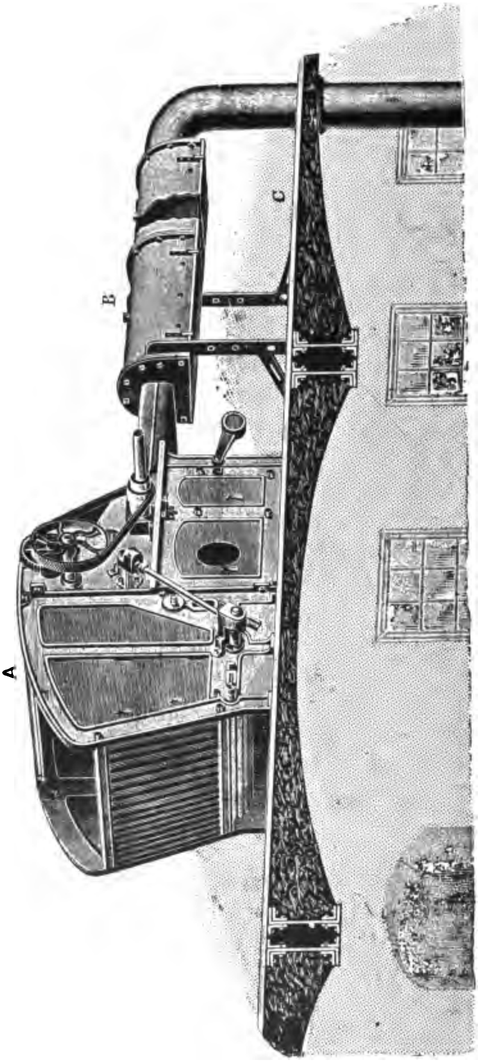


FIG. 25.

DOBSON'S EXHAUST OPENER.

Description.

This machine may or may not be made with a single scutcher and lap apparatus attached, and in connection with a porcupine opener feeder, as illustrated in Figs. 25 (*a*) and 25 (*b*). The hopper feeder can be applied at A, B, when required.

The opener consists of an exhaust fan and two porcupine cylinders, arranged to admit of a free and easy passage to the cages.

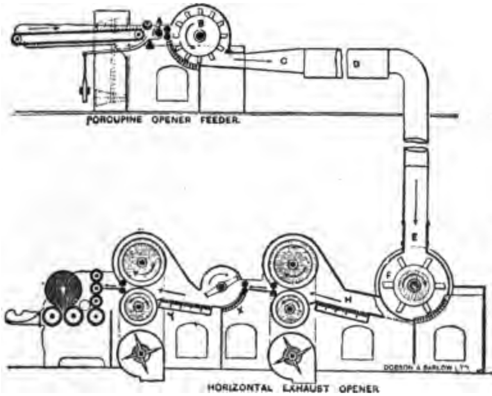


Fig. 25 (*a*).

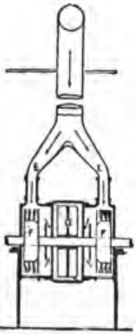


Fig. 25 (*b*).

References to Figs. 25 (*a*) and 25 (*b*).

A	Pedal Roller, Porcupine Opener.
B	Cylinder, Porcupine Opener.
C	Pipes.
D	Dust Trunks.
E	Divided Trunks.
F	Fan, Exhaust Opener.
G	Cylinder, Exhaust Opener.
H	Passage from Fan to Cage.
X	Beater Bars of Scutcher Part.
Y	Cage Bars of Scutcher Part.

The machine is provided with two sets of cages, with a dust fan to each set, cylinder bars, two sets of dust bars and dust chambers.

The beater is 16 inches diameter, and is made with two or three blades. The blades are planed on both edges, so that the beater can be reversed when one edge is worn.

The porcupine opener feeder is made 36 inches wide, and is fitted with a cylinder having hardened steel teeth, a collecting

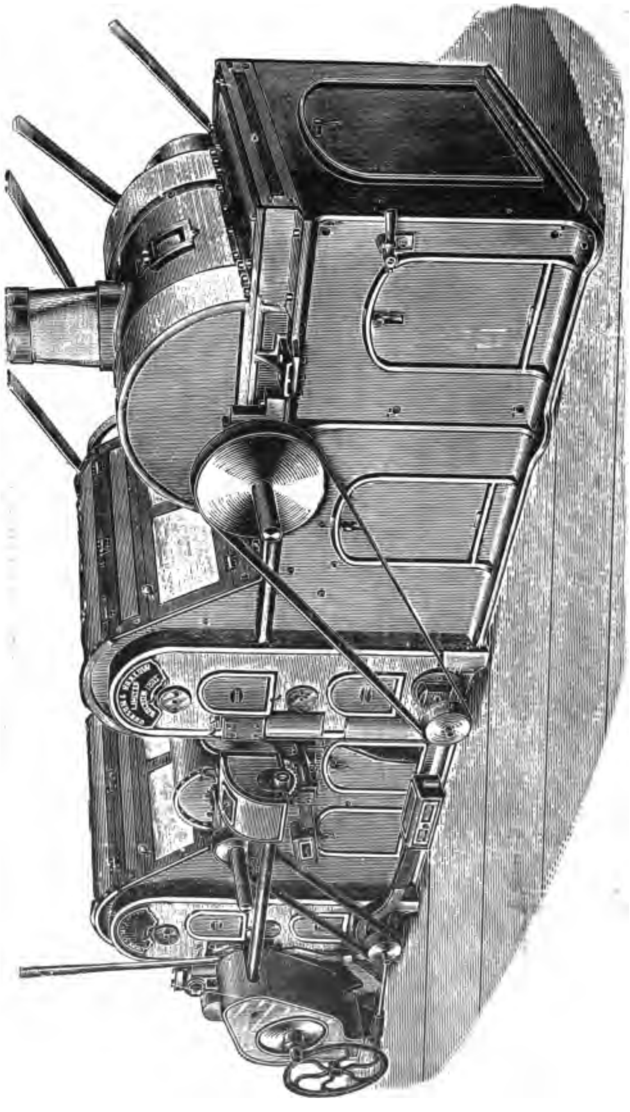


FIG. 25 (c).

roller, a fluted pedal roller, a pair of fluted feed rollers, dust bars and dust chamber.

They also apply a vertical cone feed regulator to the above feeder, which is fitted with large cones driven by gearing. The pedal motion attached has four antifriction bowls between each pendant, so as to reduce the friction to a minimum, or a still more recent two-bowl arrangement may be applied.

The porcupine feeder can be placed at any convenient distance from the exhaust opener, or may be placed in the mixing-room, in which case it is connected by tubing and dust trunks, in the manner shown in Figs. 25 (*a*) and 25 (*b*).

A connection is made between the feeder and the opener, so that when the latter is stopped the former is automatically thrown out of gear and the feeding is discontinued.

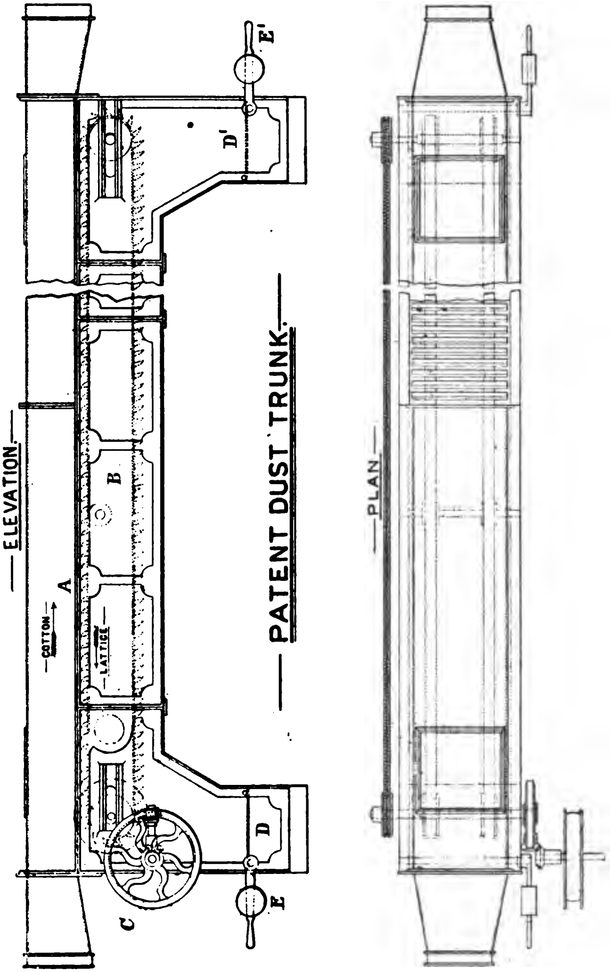
Dampers are provided to regulate the amount of air passing through the cages.

The beater covers are fitted with a locking arrangement, and can only be raised when the machine is stopped.

Platt's Self-Cleaning Lattice.

Q. 1899. What is the construction of the trunks placed between a mixing-room and the opening machines? State how far they aid in the cleaning of the cotton, and what precautions are necessary to ensure satisfactory working.

A. It is a very common practice to convey the cotton from the mixing-room to the large cylinder or beater of the opener, through long tin trunks, the cotton being impelled along the trunks under the influence of an air current induced by a powerful fan. This practice is beneficial to the cotton inasmuch as it tends to dry, and to a limited extent also to clean it. To assist in the latter operation it is usual for a portion of the length of the tube or trunk to be made of D shape with the flat side down. This side is fitted with plates which tend to catch and arrest dirt and impurities, the latter then falling into suitable receptacles convenient for removal. To ensure the regular and efficient removal of the dirt—a very necessary duty—it is sometimes the practice to fit a self-cleaning travelling lattice below the bottom flat side. At intervals the weight of the impurities accumulated in pockets at the ends of the lattice overcomes the resistance of a trapdoor, so as to drop the dirt into a bag, after which the door shuts again.



FIGS. 26 and 27.

The cotton passes on its way to the opener along the passage as shown by the arrow at A, Fig. 26.

The upper surface of the lattice, B, travels against the direction of the cotton, the lattice being slowly moved by the mechanism at C.

The dirt falls into the boxes D and D′ and rests on weighted doors.

When sufficient dirt has got into the box to overcome the resistance of the weight E or E′, the doors fall open and permit the exit of the dirt into a bag or other suitable receptacle.

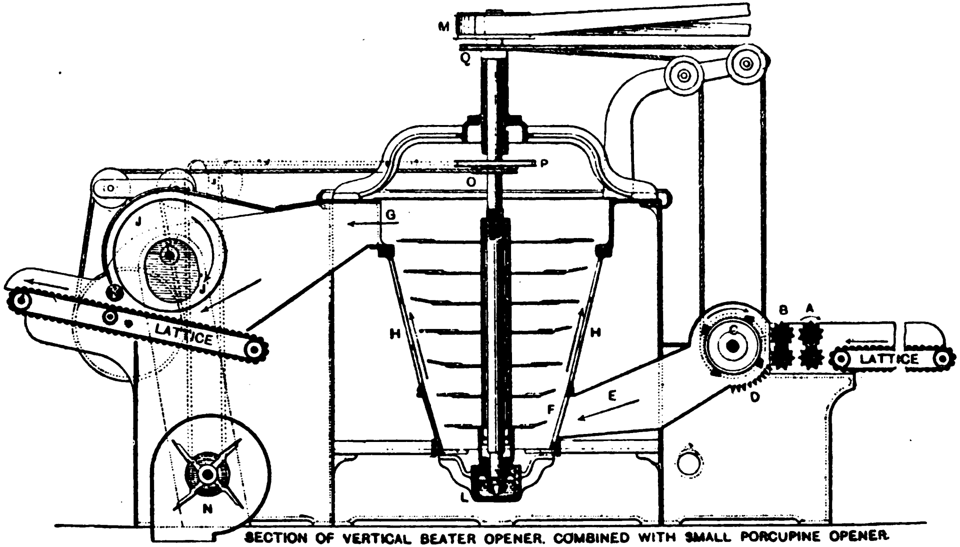
Fig. 27 is a plan of this apparatus.

It must be understood that this is only part of the long exhaust trunk used to feed an exhaust opener, and it would be at B in Fig. 25 if used at all.

Q. 1899. What is the difference in the construction of the beater of a Crighton and a Taylor & Lang opening machine? Illustrate by a sketch, and say how the blow given to the cotton differs, if at all, and say for which class of cotton each is most suitable.

A. These are two exceedingly well-known types of opener. The Crighton is a vertical conical beater, which has been so popular as to be largely made by several different firms. It consists of a strong vertical shaft which has six or seven strong discs of different diameter secured to it. The largest disc is at the top and the smallest at the bottom, the whole forming a cone. Riveted to the discs are steel blades or knives, which strike the cotton against a vertical conical grid, through which dirt passes. The cotton enters the bottom of the beater, and as it expands by opening is carried upwards under the influence of an air current. It is reckoned specially suitable for dirty, matted cottons, since the heavier a piece of cotton is the more difficult will it be for it to rise, and therefore more beating will it get, this being just the thing required. The Taylor-Lang beater is a modification of the Old Willow, and is more used than the Crighton for the better qualities of cotton. An especial feature of this beater consists in its having an upward stroke, this being considered to damage the fibre less than the down stroke, while it also gives a large amount of opening area. The cotton passes through such an opener in a more uniform manner than in the Crighton, being more suitable for cleaner and better cottons. Fig. 27 (*a*) shows the Crighton opener in a simple form as made by Messrs. Dobson & Barlow.

Crighton Opener.



SECTION OF VERTICAL BEATER OPENER, COMBINED WITH SMALL PORCUPINE OPENER.

FIG. 27 (*a*).

A, B are two pairs of strong feed rollers; C is a small porcupine beater, which opens and prepares the cotton for the large conical beater, F; D are dirt bars; E is the passage of the cotton from the small to the large beater; H is a conical grid surrounding the large conical beater; G is the outlet of the cotton from the beater chamber to the delivery lattice and the cages; L is the footstep of the large beater revolving in an oil bath; N is the fan; the parts M, O, P, Q are connected with the driving.

Taylor & Lang's Beater.

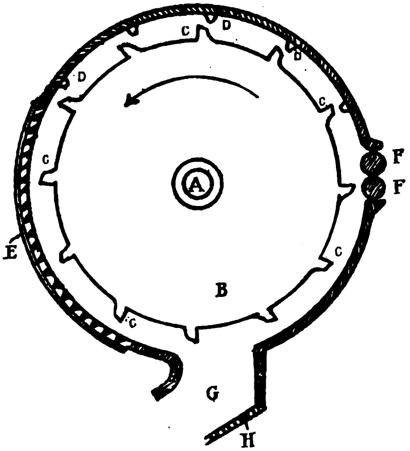


Fig. 27 (*b*).

Referring now to Fig. 27 (*b*), in this case the cotton passes through the feed rollers, F, F, or else over pedal noses, and is taken in an upward direction by the strong porcupine teeth, C, of the large cylinder, B. The cotton is thus beaten against the strong teeth or nogs, D. A good deal of heavy dirt passes through the bars at E. The cotton goes along the passage, G, to the first cages, and on its way passes over other bars as at H.

SCUTCHING.

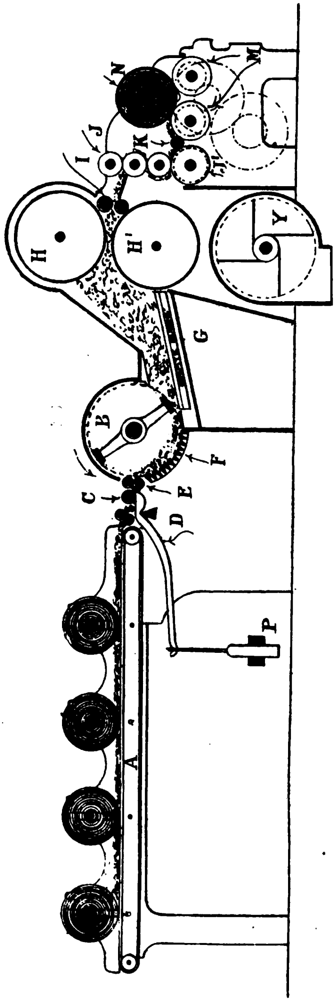


FIG. 28.—Single Scutcher, Doubling Four Laps.

General Description of Scutcher.

Referring to Fig. 28, the laps are placed on the lattice, A, and slowly unrolled by frictional contact therewith.

Frequently cotton of good staple is passed through the feed rollers, E, as well as between the pedal, D, and the pedal roller, C, but for shorter cottons there is often nothing but the pedals and pedal roller before the beater. The rollers preceding these are seldom used on any scutching machines. The cotton is beaten down upon the beater bars, F, by the beater, B, revolving at from 1,000 to 1,500 times per minute. A good deal of the impurities present in the cotton pass through the bars, F, and some of the lighter leaf, fibre, etc., through the grate bars, G, but the cotton passes upon the cages, H, H′, under the influence of an air current induced by the fan, Y. I are the cage delivery rollers, J to J′ are the compression rollers, K is a conducting roller, M are the fluted lap rollers, and N the lap.

Q. Describe the functions of the scutcher or lap machine.

A. One of the principal duties of a scutcher is to carry still further the opening and cleaning operations on the cotton, which have already been performed to a large, but not quite sufficient, extent by the opener. A scutcher does practically the same kind of work as an opener, but does it to a finer and more perfect degree.

It still further opens out and loosens the clusters of cotton fibres, and extracts a further quantity of sand, seeds, leaf and other impurities.

One of its most important uses, however, is to give a more uniform lap than it is usually possible to get from the opener.

This uniformity is secured by the use of the piano-feed regulator, and by doubling together usually three or four laps on the scutcher feed lattice.

A further benefit secured from the use of the scutcher is the blending of the cotton by working together three or four different laps.

In many cases for American cotton a second or finisher scutcher is used, so as to obtain the foregoing benefits to a still further degree.

In nearly all cases of Egyptian cotton one scutcher is deemed sufficient, and there is a tendency towards this practice for American cotton, since the introduction of bale-breakers and hopper feeders, and the application of lap ends to openers.

Before it became the practice for openers to make laps the cotton had to be fed by hand to the first scutcher. A given weight of cotton was supposed to be always spread evenly over a definite and marked portion of lattice, in order to secure uniform laps. This practice is now almost obsolete in cotton spinning.

Here it is considered advisable to introduce the gearing plan of a well-known make of scutcher, (Fig. 28 (*a*)). This illustration is practically self-explanatory. It is made by Hetheringtons.

Q. 1900. What is the true relation between the fans and dust cages in cleaning cotton? How should the fans act (*a*) when throwing the cotton on the cages; (*b*) when drawing it on? What are the faults to avoid (1) in the velocity of the fan; (2) in the construction of the passages through which the air is discharged?

A. Apart from assisting to form a very convenient and effectual condensing arrangement, the fans and cages play a most important part in cleaning the cotton. In the first place a fair quantity of fine light dust, etc., that would not otherwise be extracted, enters the apertures of the cages and passes into the dust chambers.

Since the fresh air to supply the partial vacuum created by the fan has in many cases to enter a scutcher principally at the grate bars, it follows that the strength of the air current exercises an important influence on the cleaning of the cotton at this position. If the current of air entering the grate bars be too strong, then it prevents the impurities from dropping out with sufficient freedom. The fans should act with sufficient force to take the cotton from the beater to the cages uniformly, without being so strong as also to take the impurities forward with the cotton.

This is the great principle involved in all cases of openers and scutchers. The faults to avoid in the velocity of the fan are (*a*) too high a speed, (*b*) too low a speed. The velocity should be as indicated above.

The air passages should be constructed so as to avoid sharp turnings, contracted outlets for the air, back pressures and accumulations of dirt inside.

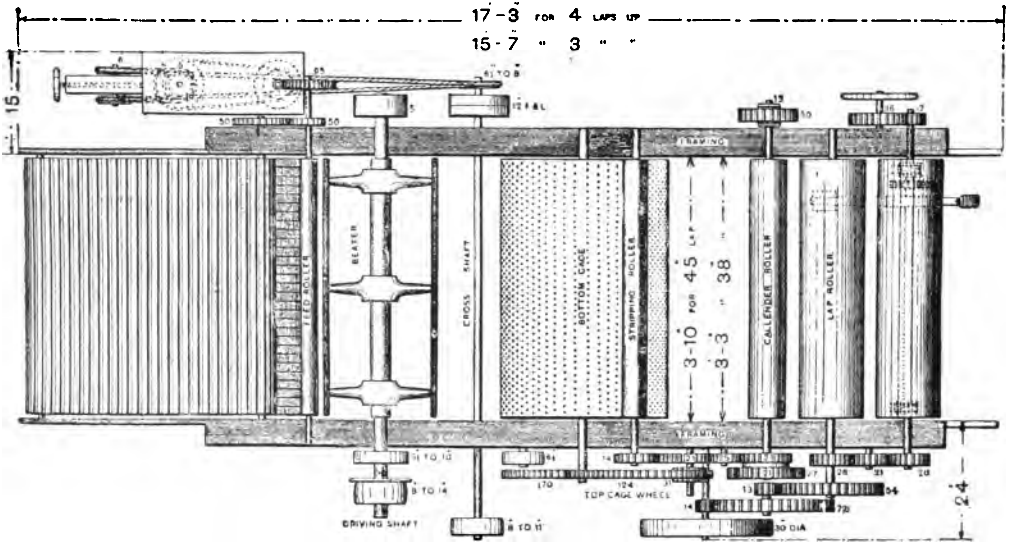


FIG. 28 (*a*).—GEARING PLAN OF SCUTCHER.

Q. 1896. Describe the construction of the dust cages of a scutching machine. How do they help to form the laps? Under what conditions would they tend to produce split laps?

A. The cages are usually made of perforated zinc or of wire netting, and they are always cylindrical, and work in pairs. They are connected at the ends to vertical dust trunks, through which the air is exhausted by a fan placed either above or below the machine, the latter method being the better on account of the dust being carried away more effectively. The ends of the cages should always be well lined, so as to prevent air from passing between the framing and the ends of the cages. The cages very materially assist in forming an even lap or sheet of cotton. The latter is drawn away from the beater by the air current and deposited upon the cages. As one set of perforations in the latter become blocked up with cotton, the air rushes through the holes still open, carrying the cotton to the empty portions of the cages so as to form a somewhat uniform sheet. This action is continually taking place, and is a very effective principle. It is very commonly taught that making the cages both of one size has a great tendency to cause laps to split. In this case it is said that half the cotton will fly to the top cage and half to the bottom cage, and the lap will be composed of two different layers which will readily part. This difficulty in many machines is overcome by making the top cage much larger in diameter than the bottom cage, and consequently most of the cotton flies to the top cage, and that portion which goes upon the bottom cage becomes absorbed with the cotton on the top cage so as to form one solid sheet. There is probably something in this argument, but the author is bound to observe that he knows of many machines which have cages both alike in size and yet the laps from these machines seldom split. However, it may be considered good practice to have more surface of the top cage exposed to the cotton than of the bottom one.

CAGES.

The sketches, Figs. 29 and 30, give different views of the cages. The perforations of the cages are shown at C (Fig. 29). At A are the chimneys or passages for the air from the inside of the machine to the fans, the air first passing through the apertures of the cages. D and D′ are the shafts of the cages, whose revolution is very slow. At B are shown adjustable dampers, which can be set so as to expose more or less of the apertures of the cages to the inlet of the air,

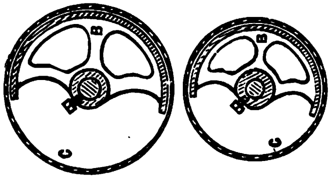


FIG. 30.

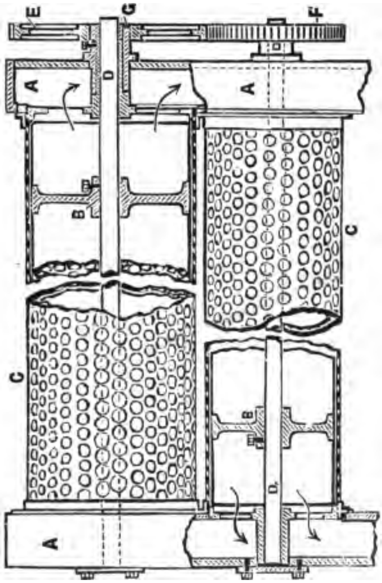


FIG. 29.

and at the same time can block up the apertures on the non-active sides of the cages. At E, F are the driving wheels of the cages.

Q. 1898. Describe the mechanism of a lap machine attached to a scutcher. What advantage is produced by using laps?

A. The mechanism for forming the lap may be said to commence with the cages. The air passing through the apertures of the cages places the cotton on the outside of the cages, so as to cover practically all the perforations in succession, so that the cotton may be said to be formed into a loose sheet between the cages. Leaving the cages, the cotton passes between a pair of cage delivery rollers, and then between two or four heavy calender or compression rollers. There is a difference of opinion as to whether two or four calender rollers is the better practice. With four rollers the cotton passes between the rollers so as to be calendered three different times. In any case, the cotton leaves these rollers in a more or less cohesive sheet, which is immediately wound upon a smooth lap roller by frictional contact with large fluted lap rollers, upon which the lap rests during formation. Frictional contact between the lap and the large fluted rollers is greatly increased by a vertical rack and brake pulley and lever arrangement, which holds the lap down with a very considerable pressure. There are several advantages obtained by using laps. A lap needs much less attention and handling, either at the next scutcher or at the card, than the loose cotton would do. If a scutcher is used after the machine which makes the lap, then greater uniformity of the finished lap may be obtained by doubling three or four laps together.

These parts differ very little with different machinists except that in some cases only two calender rollers are used.

Q. In what state does cotton clean best, damp or dry?

A. In the blowing-room dry cotton will open out and clean much more readily than damp cotton, the dampness resisting both the opening and cleaning actions by causing the cotton to cling together. Damp cotton also sticks to the machinery. On the other hand it may be added that if the cotton is excessively dry and fluffy it becomes susceptible to the influence of electricity, and is attracted towards the beater shaft, and tends strongly to give lap-licking.

Q. 1900. Sketch and describe the lap mechanism of an opening or scutching machine. How is a definite length of lap ensured? If the lap mechanism is used in connection with the feeding mechanism some distance away, how are the two mechanisms connected so as to ensure continuity of delivery?

A. Fig. 31 shows the parts through which the cotton passes after leaving the beater. The lap-forming mechanism may be said to begin with the cages, and comprises the cages, the cage delivery rollers, the calender rollers, the fluted lap rollers, the tubular lap roller and the knocking-off motion. On the cages the cotton is condensed and arranged in the form of a sheet of cotton, which is consolidated by the heavy pressure of the two or four calender rollers. The fluted lap rollers sustain the lap and rotate it during its formation by frictional contact with it. The lap is formed on the tubular lap roller.

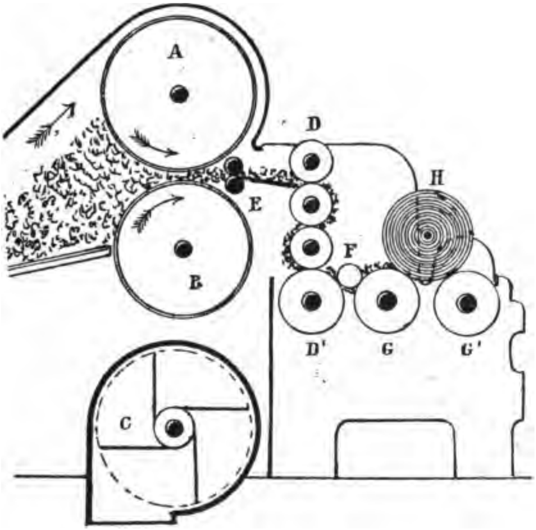


Fig. 31.

A, B	are the Cages.
C	is the Fan.
D to D′	are the Calender or Compression Rollers.
E	are the Cage Delivery Rollers.
F	is a pressure or Guide Roller.
G, G′	are the Fluted Rollers which cause the Lap to slowly revolve.
H	is the Lap shown full diameter ready for doffing.

It is the duty of the knocking-off motion to ensure a definite length of lap, and this it does by automatically stopping the feed and delivery of the cotton when the lap has attained a definite length. There are various makes of knocking-off motion, but they are usually operated from one of the calenders or one of the fluted lap rollers, and the principle of action is in every case the same.

In the case of hopper feeds it is necessary to stop and start this apparatus at the same time as the feed rollers of the opener, and it is done in some cases by simply connecting the rods and levers of the knocking-off motion forward to the requisite parts of the hopper. This principle is still further extended in the case of cotton being fed to an opener through long exhaust trunks, to prevent the trunks getting surcharged with cotton on the one hand, or undercharged on the other hand. In this case, at the commencement of each lap, the rollers at the feeder are started a short time before the lap part of the opener, and at the finish the feeder stops the same length of time before the lap part. By this means the trunk and pipes are freed from cotton when the lap part stops, and thus the irregularity caused by the cotton falling in the trunk is obviated. The connection between feed and delivery is automatic.

Knocking-off Motion.

Fig. 32 shows a knocking-off motion as made by Messrs. Dobson & Barlow, and is on the Hunter cog principle.

A is the shaft of the bottom calender roller; on A is the wheel, B, carrying the pointed snug, *a*. Wheel B drives wheel E, and the latter carries a grooved stud, *b*. The bearing of wheel E is in the lever, K, which is fulcrumed at the top.

Suppose wheel B contained 62 teeth, and knocking-off wheel, E, 43 teeth, it would take 62 revolutions of the knocking-off wheel, or 43 revolutions of the calender roller, before the two snugs, *a* and *b*, would come together and the wheel, E, be pushed outwards, as these wheels have no common measure. If, on the other hand, the sizes were $\frac{42}{63}$, this would in effect equal $\frac{2}{3}$, and the calender roller would only make two revolutions before knocking-off took place.

The rule for finding length of lap before knocking-off takes place is to multiply the circumference of the calender roller by the teeth in the knocking-off wheel, E, and reduce the answer to yards. E is a change wheel, and a larger wheel gives a longer lap.

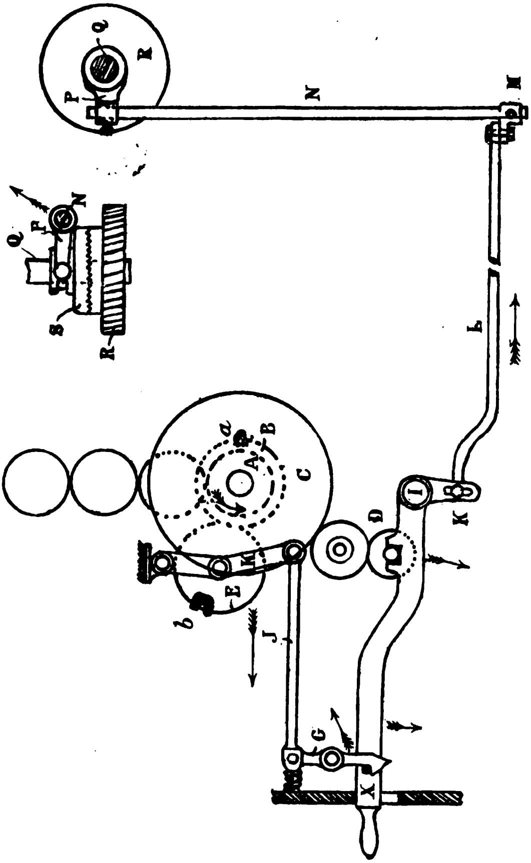


FIG. 32.

Action of Parts.

Whenever wheel E is pushed outwards the arm, J, moves, as shown by the arrow, thus oscillating the upright lever, G, on its fulcrum in the middle, and releasing the stop or stud at X. The drop lever, X, I, then falls on the fulcrum, I, and disengages the wheel, D, so as to prevent this wheel, D, from giving further motion to the calenders. The rod, L, moves in the direction shown, and opens the clutch-box at S, and thus stops the feed rollers. Q is the pedal roller; R is the pedal roller wheel; N is the fulcrum for the fork of the clutch.

Another motion is shown at the end of scutching answers, in Figs. 41 and 42.

Q. 1898. Describe and sketch the construction and position of the dirt bars in a scutching-machine. What is the general rule for setting them, and what is the effect if set too widely?

A. The dirt bars in a scutching machine are placed below the beater for practically the first quarter of the circumference of the circle described by the beater in its revolution. They are of triangular section, and set so that the strongest sharp edge shall be presented to the cotton as the latter is struck down by the beater. There may be about twelve of these bars below each scutcher beater, and they may be set in a part circle, which is concentric with that described by the beater, but about a quarter-inch further away, or the later bars may be set a little further away from the beater than the first bars. The first bar may be about a half-inch below the bottom feed roller, and the bars may have about a quarter-inch space between each pair. If these dirt bars are set too widely there will be a tendency for good cotton to pass through the bars along with the seed.

In the general view of scutcher given on page 74, the common arrangement of beater bars may be seen at F.

Also in Fig. 25 (*a*), at X, are shown the beater bars, and at Y the dust bars or cage bars.

Q. 1900. What is the principle upon which the dirt bars of opening and scutching machines are constructed and set? What happens if they are not in proper order or are improperly set? A clear and detailed answer is required.

A. These bars should be set so as to allow of the maximum quantity of dirt, seed, sand or leaf and other impurities to fall out, with the minimum amount of good fibre. This is the object and principle aimed at in their construction and setting. Each bar requires to offer a strong section to the blow of beater, and a somewhat sharp edge to the entry of the air, so as not to cause deflection of the same. There are differences of opinion amongst practical men as to details in the setting of the bars. Sometimes the bars are all concentric to the path of the beater, while in other cases there is a variation from this practice. On an opener especially the first bars are often set more openly than the later ones. If the bars are not kept in proper order and adjusted to the best advantage it may happen that on the one hand a good deal of good fibre escapes with the impurities, or, on the other hand, the cotton is insufficiently cleaned.

Beater and Beater Bars.

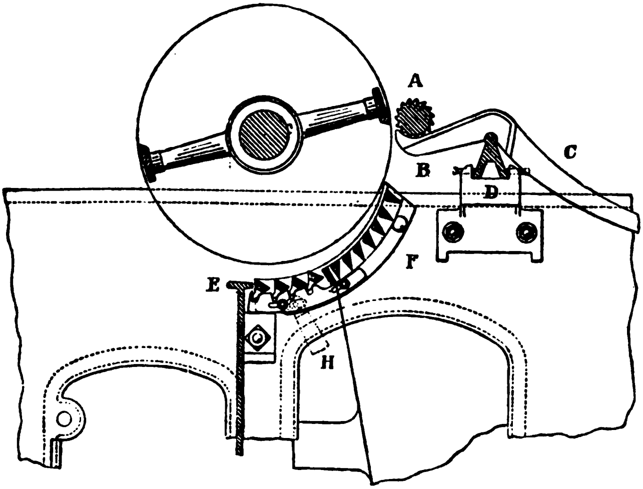


Fig. 33.—For Short and Medium Stapled Cotton beaten from Pedal Nose.

Figs. 33 and 34 show two views of a special beater and beater bar arrangement as made by Howard & Bullough, and, along with other illustrations, reproduced with the kind permission of this firm. In each case the feed or the pedal rollers are shown at A, one of the pedals at B, C, working on the knife rail, D, as a fulcrum, while the beater bars are shown at E, F.

The principal feature of this arrangement consists in the four bottom bars being readily adjustable by means of the handles, H, conveniently placed outside the framing. In this way the angle and opening of these four bars can be easily altered.

It may also be pointed out that for short or medium staple cotton, such as Indian and American, the pedal roller set next to the beater, as shown in Fig. 33, is often used, as it allows close setting of the beater to the nip of the cotton.

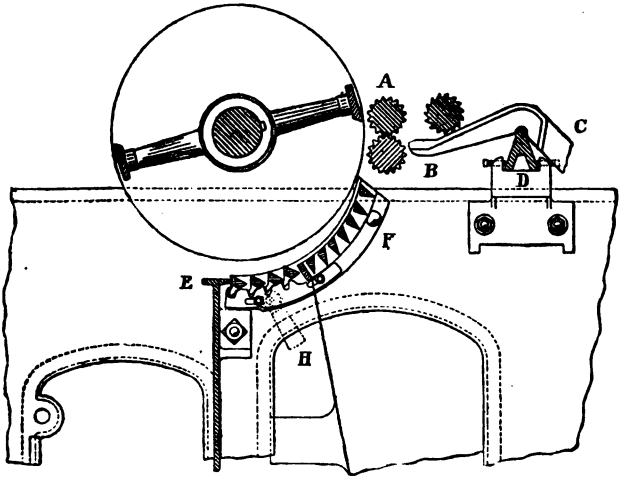


FIG. 34.—For Long Stapled Cotton beaten from Feed Rollers.

On the other hand, this is considered injurious to long staple cottons, such as Egyptian and Sea Islands; and the extra feed rollers at A (Fig. 34) are preferred next to the beater.

It may also be pointed out that the lower beater bars in the above sketches are farther from the beater than the upper bars, this being preferred by some to provide more space for the cotton as it becomes more loose and open. In many cases, however, the bars are found to work well when set concentric with the beater, as shown in the general view of scutcher previously given on page 74.

FEED REGULATORS.

Q. 1897. Describe and sketch the piano-feed motion as applied to a scutching machine. Say how it regulates the treatment of the cotton, and what effect it has upon the lap.

A. The piano-feed regulator is probably the most interesting apparatus about a scutcher. Invented originally by Mr. E. Lord, of Todmorden, it is now an indispensable adjunct to any scutcher in one form or another. The object of the motion is to regulate the feed of the cotton in such a manner as to greatly aid in the production of an even lap. The cotton passes over a series of levers (from sixteen to twenty-six) of the first order, at a point only a few inches from the fulcra, the total length of the levers approximating to about two feet, and the long ends of the levers extending backwards underneath the feed lattice. Hung at the back extremities of the levers are pendant rods—one to each lever—with the lower ends swelled out or fan-shaped, and passing between a number of bowls in the bowl box. The bowls are free to move laterally, and their movement is transferred by a series of levers to the cone drum belt and from the convex or driven cone to the feed rollers. Assume now that the cotton is being fed too thickly all along the feed roller length, this roller being placed over the noses or extremities of the short arms of the levers. The noses of the levers or "swan necks" are at once pressed down, and consequently their back ends are raised up, this bringing the swelled out lower ends of the pendants to press against the bowls in the bowl box. The bowls can only slide towards the cone drum levers, as they are prevented from sliding the other way by an adjusting screw, which is screwed up slightly when lighter laps are required and unscrewed when heavier laps are required. This lateral movement of the bowls in the bowl box acts on a special pendant at the end, and thereby upon certain levers which are connected to the cone drum belt in such a manner as to move the latter towards the thick end of the driven cone, and therefore to slower its revolutions and also those of the feed roller. An important feature of the piano-feed regulator is that it compensates to some extent for the cotton being thick at some places and thin at others simultaneously. Suppose, for instance, seven pendants are raised by thick pieces of cotton passing beneath the feed roller, and seven pendants are lowered by thin pieces of cotton passing along to the same extent. One lot would compensate for the other in the bowl box, so that the rate of feeding would remain the same. If seven were up and four only were down the motion would give compensation for the difference of three levers up. By recent and admirable improvements friction in the bowl box is greatly diminished by having two, three or four bowls between each pair of pendants instead of only one. Often an extra pair of feed rollers is used between the pedals and the beater to prevent damage to the fibres and to prevent plucking.

Triple Bowl Regulating Motion.

Fig. 35 shows the parts necessary to describe the action and construction of the feed motion of a scutcher, and is sub-divided into four different views. These are intended to show the piano-feed regulator as made by Howard & Bullough. The cotton passes under the feed roller, A (Figs. 1 and 2), and therefore over the noses or front extremities of the pedal rollers.

If the cotton be too thick its density causes a depression of the pedal noses, and therefore an upward motion of the hooked extremities at B (Figs. 1 and 2). In this way the pendant rods or fantail rods are lifted so as to bring the thicker portions of their wedge-shaped lower extremities into the bowl box, C. This causes a movement of the rods and levers, D, E, F (Figs. 1 and 2), in such a manner as to act on the sector levers, G, and to raise the cone belt up the cones.

As the belt, then, works on a thinner portion of the concave driving cone, H, and a thicker portion of the convex driven cone, I (Fig. 1), the worm, J, gives a slower revolution to the worm-wheel, K, and the feed roller, A.

Improved Bowl Arrangement.

The construction and arrangement of the bowls and other parts of the piano-feed regulator motion have been improved by various makers, so as to prevent friction amongst the bowls and pendants, and to secure prompter action of the parts.

PATENT TRIPLE BOWL PEDAL FEED REGULATOR TO SCUTCHER.

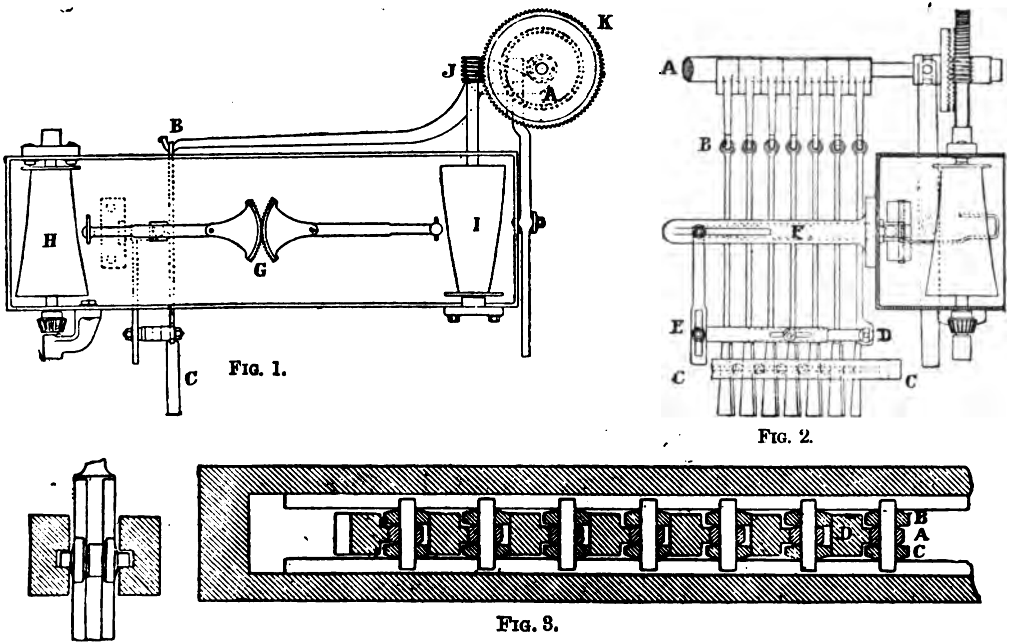


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 35.

Figs. 3 and 4 show Howard & Bullough's improved arrangement. On each small cross stud are mounted three bowls, A, B, C. The centre is of less diameter than B, C, and is only acted upon by a projection on the pendant, D, on one side. The two outside bowls are acted upon by the other side of the pendant. In this way the pendants and bowls do not exercise any opposite frictional effect on each other, as was formerly the case. An end view of one stud and the three bowls is shown (Fig. 4), and should give an idea of how the bowls are allowed to slide freely in the bowl box.

Q. 1896. What would be the effect if the scutcher blades of a scutching machine struck the cotton too often, or too seldom, during every inch delivered by the feed rollers?

A. The effect of overbeating the cotton would be to cut and brake the fibres in such a way that the same strength of yarn could not afterwards be got from the cotton. Besides this, more waste would be made. These effects the author has personally witnessed, and would advise all concerned to be careful to have the speeds of their beaters accurately taken, so that they will know where they stand in the matter.

A short time ago a spinning firm of some importance with which the author is acquainted had great complaints over bad spinning and weak yarn. Upon examination it was found that the beaters of the scutchers were making over 3,000 strokes upon the somewhat soft American cotton used. Two thousand strokes per minute would have been nearer the mark, and the speed of the beaters was immediately reduced, with distinctly beneficial results.

Of course, if the speed of the beaters is too low then the cotton will not be sufficiently opened to allow of the various impurities being taken out, and the cotton will not be delivered in that open, fleecy condition so desirable at this stage. Clearly the best plan is to obtain a medium speed by which the impurities can be extracted to a sufficient degree without cutting the fibre. When the speed of a beater is increased its striking energy or force is increased to a greater degree than most practical men would imagine.

Q. Is there any advantage in using double the number of scutchers generally employed, in order to diminish the work done by the cards?

A. So long as practically all the heavy impurities are extracted from the cotton before the latter reaches the card there would be little or no advantage in using double the usual number of scutchers.

Certainly we might tend to get a somewhat more uniform lap from the last scutcher on account of the extra doublings.

On the whole, however, there can be no doubt such a procedure would be a positive evil and a great loss. The cotton would suffer more or less injury in the extra scutching; there would also be the first cost of the extra machines and the expense of working them.

The carding engine separates and individualises the fibres, and extracts short fibre and fine impurities in a manner that no amount of scutching could possibly do.

Q. If a lap was unrolled and a yard in length weighed, what weight should it be for 60's twist?

A. It would depend somewhat upon whether it was an opener or scutcher lap, as it is customary to make opener laps heavier than scutcher laps.

In actual practice it might be expected that an opener lap of 13 oz. per yard and a scutcher lap of 11 oz. per yard would give good results.

It may be added that in practice it is the usual way to wrap scutcher laps by measuring off one or two yards in the manner indicated by the question. Also it is common to weigh the full laps.

Q. What are the relative merits and demerits of double and treble blade beaters?

A. In favour of the double-blade beater it may be said that the quicker speed permits of a somewhat sharper and cleaner blow. Since the energy of a quickly revolving beater is very much greater than that of a much slower one it follows that the blow of the double blade is heavier than that of the three-blade, and this is a somewhat strong point in the cleaning of dirty and matted cottons. It is less costly than the three-blade, and may occupy rather less space.

In favour of the treble blade it may be said that the lower number of revolutions required to give the same number of blows per minute leads to less wear of the beater bearings.

Again, although the force of blow is reduced by the lower speed, yet the introduction of bale-breakers and hopper-feeders to openers have made it less necessary for beaters to make such heavy blows on the cotton.

Be that as it may at the time of writing the three-bladed beater is receiving far more adoption than the two-blade.

Fig. 36 shows a three-bladed beater, and two-bladed beaters are shown in several previous illustrations. A is the beater shaft, B, B, B are the beater blades, C′ and C″ are the feed rollers, D is the pedal roller, and E the pedal nose.

Q. Write out the table of cotton yarn measure.

A. 54 inches = 1½ yards = 1 thread.
120 „ = 80 threads = 1 lea.
840 „ = 560 „ = 7 leas = 1 hank.

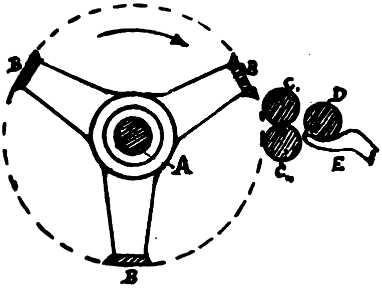


FIG. 36.

Q. Write out the table of avoirdupois weight used for weighing cotton yarns from grains to pounds.

A. 24 grains = 1 dwt.
437½ „ = 18 dwt., 5½ grs. = 1 oz.
7000 „ = 29⅓ „ 16 „ = 1 lb.

STEEL LAP RODS.

Cotton mills are now usually equipped with steel lap rods, although some still use wooden ones.

The steel lap rods are best, and the cost is about the same as well-made wooden ones. They are more durable than wooden ones, and reduce the amount of lap waste to almost none at all, in many cases.

One end of the lap roll bearing has a hole through which the rod is inserted when the lap is ready to doff.

It is evident that no damage can be done to the inside layers of the laps as happens when the lap stick has to be twisted into the lap after the roll is drawn out.

When the lap roller, B (Fig. 37), is drawn out of the lap, C, the steel rod is left inside, and the large head of the rod at A keeps the rod in position.

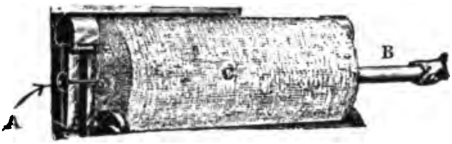


FIG. 37.

A separate and enlarged view of the lap rod is shown in Fig. 38.

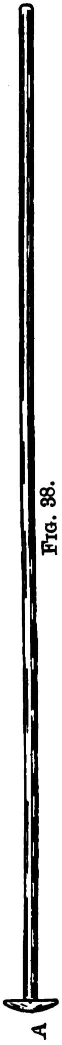


FIG. 38.

VARIOUS CALCULATIONS.

Q. A finisher scutcher will produce from 12,000 to 18,000 lb. of laps per week. How many finishing scutchers will be required for a mill containing 70,000 mule spindles spinning 60's twist, and producing 23 hanks per spindle per week?

A.
$$\frac{70{,}000 \times 23}{60} = 26{,}833{\cdot}3 \text{ lb.}$$

of yarn produced. Presuming it to be carded yarn (not combed), it would be reasonable to allow from 9 to 12 per cent. for loss after scutching, which would bring the production required from the scutchers to equal about 30,000 lb. Two scutchers, therefore, would be nicely suited to do the work.

Q. The fly wheel of a steam engine is 28 feet diameter, and makes 50 revolutions per minute, and drives a pulley of 5 feet diameter in the line shaft, A. On this shaft is a drum 30 inches diameter, driving a pulley 18 inches diameter on counter shaft, B, and on this is a drum 30 inches diameter, driving a pulley 12 inches diameter on scutcher beater, C, and a pulley 12 inches diameter drives a pulley 10 inches diameter on fan, D. What is the speed of the fan?

A. $$\frac{28 \times 50 \times 30 \times 30 \times 12}{5 \times 18 \times 12 \times 10} = 1{,}400 \text{ revolutions.}$$

Q. If two single scutchers taken together are producing 1,012 laps of 33 lb. each, one lap is made in 5 minutes 15 seconds, and it takes 8 seconds to doff, what time is taken up in cleaning the machine, and what is the weight in pounds produced from each scutcher in a week of 56½ hours?

A. Both scutchers together produce per week

(1) $33 \times 1012 = 33{,}396$ lb.

Each scutcher produces

$33{,}396 \div 2 = 16{,}698$ lb.

(2) To make each lap requires

5 minutes 15 seconds = 315 seconds.

Plus 8 seconds for doffing = 323 seconds.

Each scutcher makes 506 laps, and

$506 \times 323 = 163{,}438$ seconds

occupied in working the machines, the rest of the 56½ hours being left for cleaning.

In 56½ hours there are 203,400 seconds.

$203{,}400 - 163{,}438 = 39{,}962$ seconds.

Reduced, this comes to 11 hours 6 minutes and 2 seconds left for cleaning purposes.

Q. 1897. The cone pulleys of a scutching machine are driven by a side shaft, the sizes and dimensions of the various parts being as follows, beginning at the feed roller:—

Feed roller diameter . .	2½ or 2·5	inches.
Feed roller worm wheel . .	88	teeth.
Driving cone bevel wheel . .	20	,,
Side shaft cone bevel . . .	72	,,
Side shaft driven bevel . .	26	,,
Bevel pinion on pulley shaft .	30	,,
Lap end pulley diameter . .	20	inches.
Beater shaft pulley diameter .	6	,,

Revolutions of beater per minute, 1,200.

What is the speed of the feed roller, and how many inches will it deliver per minute?

A. (*a*) $$\frac{1200 \times 6 \times 30 \times 72 \times 1}{20 \times 26 \times 20 \times 88} = 16{\cdot}99,$$ or practically 17 revolutions per min.

(*b*) Taking the revolutions at 17, the inches will be

$$3{\cdot}1416 \times 2{\cdot}5 \times 17 = 133{\cdot}518.$$

Note.—In this solution the cone drums are taken as being alike in diameter, and the worm is assumed to be a single thread, as it usually is. The cone drum box in this case is probably laid horizontally, and the cones themselves in a vertical manner, as shown in Fig. 39 below.

Q. 1900. The feed roller of a scutching machine is 2¼ inches diameter; the worm wheel on its axle has 86 teeth, and is driven by a single worm. The strap is assumed to be on equal diameter of the two cones. The driver cone has a bevel pinion on its foot with 25 teeth, and is driven by a wheel on the regulator side shaft with 72 teeth. The regulator side shaft is driven by a bevel wheel with 30 teeth, gearing with the regulator shaft wheel with 36 teeth. The bottom cross shaft wheel with 12 teeth drives the drop shaft wheel with 65 teeth, the latter being compounded with a pinion with 12 teeth driving the lap-roll wheel with 72 teeth. The lap-roll is 10 inches diameter. What is the draft of the machine?

A.

$$\frac{10 \times 12 \times 12 \times 36 \times 25 \times 86}{2\tfrac{1}{4} \times 72 \times 65 \times 30 \times 72 \times 1} = 4{\cdot}9 \text{ draft.}$$

Figs. 39 and 40 show the parts involved in the two last calculations.

A is the Feed Roller.
B the Feed Roller Wheel.
C the Worm driving B.
D the driven or convex Cone Drum.
E the driving or concave Cone Drum.
F Bevel on end of driving Cone.
G Bevel on side Shaft which drives F.
H Bevel on the other end of side Shaft receiving motion from Bevel Wheel, I.
J Bottom Cross-shaft Wheel.
K Wheel on Drop-shaft driven by J.
L Pinion on same Shaft as K.
M Lap-roller Wheel.
N Lap-roller.

Fig. 40 is a plan of the parts at the delivery end of the machine.

Q. 1899. It is desired to make on a scutching machine a lap 30 yards long. The calender roller is 7¼ inches diameter. The knocking-off wheel has 40 teeth, and is driven by a change pinion, which is on the same spindle, with a worm wheel with 35 teeth, this being driven by a single worm on the

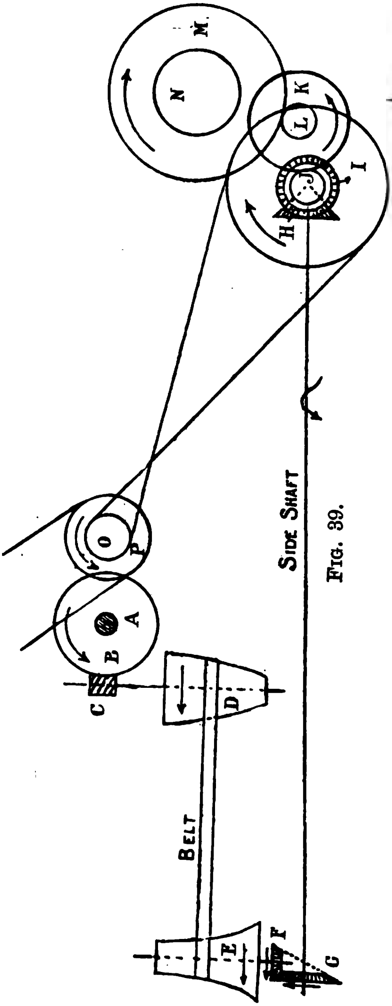


FIG. 39.

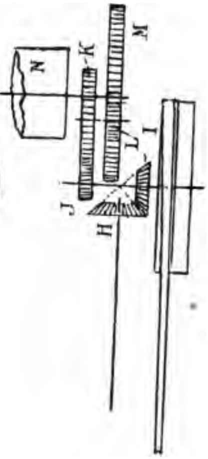


FIG. 40.

calender roller spindle. What change wheel is required?

A. $$\frac{7{\cdot}25 \times 3{\cdot}1416 \times 35 \times 40}{1 \times 30 \times 36} = 29{\cdot}526.$$

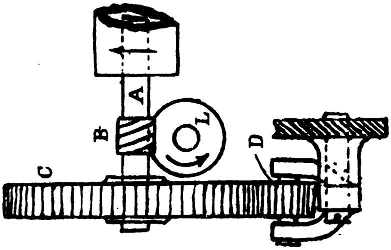


FIG. 42.

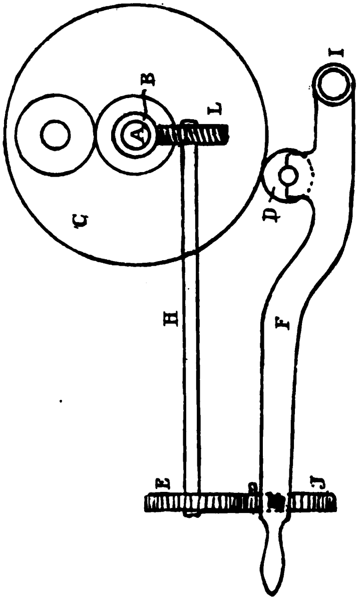


FIG. 41.

Figs. 41 and 42 illustrate the motion referred to in this question.

A is the shaft of the bottom calender, B is a single worm on calender shaft. The worm wheel is marked L, and receives motion from worm, A. At the other end of the short shaft, H, is the change wheel, E, giving motion to the knocking-off wheel, J, which carries a stud or snug. F is the drop-shaft, having its fulcrum at I, and carrying the wheel, D, which gives rotation to the calender roller wheel, C. When the knocking-off wheel, J, has made a full revolution, the stud or snug which it carries removes a supporting stop or catch from beneath the drop lever, so that the latter moves round on the hinge at I, and disconnects the wheel D from C.

A larger change wheel at E would give a proportionately shorter lap.

NOTES.

It may be added that openers and scutchers should have strong framing to ensure perfect rigidity. Every attention should be given to the various details to enable the machines to be run at the highest speeds without material vibration and with a minimum of friction. Beater and fan pedestals should be of the oil-retaining type, so as to ensure perfect lubrication and easy running. Cross rails and seatings are sometimes milled, while fan ends and frame sides should be perfectly airtight, so as to increase the efficiency of the current of air.

The steel or iron cleaning bars placed before the cages may be straight bars arranged either parallel with the cages or parallel with the sides of the machine; or they may be of some special shape, such as herring-bone shape.

Most firms have various specialities, which are regarded as extras and not applied on all machines. Messrs. Howard & Bullough make the following:—

(1) *Automatic Timing arrangement* for feeding the cotton into two hopper feeders from a Crighton or exhaust opener, so that the material is supplied to each machine alternately as required.

(2) *Lap-threading arrangement* for guiding the lap between the bottom calender rollers, thus dispensing with the somewhat dangerous operation of doing the same by hand, or of spitting on the roller.

(3) *Lap Doffing and Cutting Motion,* for removing laps without stopping the machine.

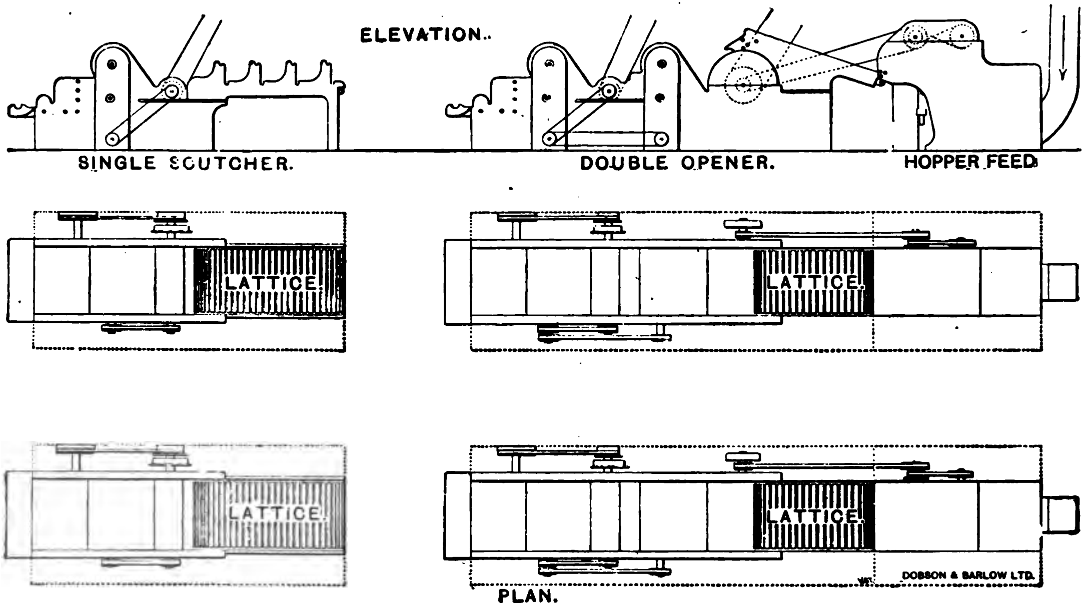

ELEVATION..
SINGLE SCUTCHER.
DOUBLE OPENER.
HOPPER FEED.
LATTICE.
LATTICE.
LATTICE.
LATTICE.
DOBSON & BARLOW LTD.
PLAN.

FIG. 42 (*a*).

(4) *Lap Safety Motion,* for wrapping the cotton round lap roller when commencing a new lap.

(5) *Lap Dish,* for receiving the finished lap when broken off, thus allowing the roller to be replaced and the new lap started before carrying the finished one away. In some cases this is not taken in any way as an extra.

(6) *Locking Device,* to prevent beater cover or glass door from being lifted when machine is working.

Q. 1901. Detail the points at which in a combined feeding, opening and scutching plant the cleaning of the cotton takes place, and state what is the character of the waste driven out at each point.

A. The outline of such a combination is shown in plan and elevation in the accompanying Fig. 42 (*a*). Such a combined machine may be said to consist of three parts: (1) the hopper feeder, (2) the large opener beater or cylinder with its companion parts, (3) the scutcher beater of two or three blades, along with the lap-forming mechanism, dirt bars, cages and fans. The actual cleaning of the cotton is done principally by the beaters of the opener and scutcher, which open and loosen the cotton, so that the bulk of the heavier impurities either fall or are driven through the dirt bars placed conveniently.

Starting at the feed of the combined machine it may be said that a moderate amount of dust is liberated by the action on the cotton of the various parts of the hopper feed. In some cases sufficient dust is discharged into the surrounding atmosphere by a hopper feeder to warrant the application of special fans to the top of the hopper in order to remove the dust. Next we may place beater bars or grids of the opener through which more heavy impurities are discharged than at any other one place.

Next are the grate bars placed between the first pair of cages and the large cylinder or beater, and through which are passed a fair proportion of finer and lighter impurities, such as leaf, etc. Sometimes the term "leaf extractor" is applied to special arrangements of these bars.

There is always a good deal of the finest dust and dirt forced inside the cages, through the chimneys and along the dust flues to the dust chamber, under the action of the fan draft.

The second, third and fourth of the above actions take place over again at the beater bars, cage bars and cages of the scutcher parts; almost the only difference being that the amount of waste taken out at the scutcher is less than at the opener.

CHAPTER IV.

CARDING.

Q. Describe the leading facts in the history of the flat card?

A. Originally hand cards were used. Short pieces of wire were fixed at a certain angle into leather, and the latter fastened on a flat piece of wood, say, about a foot long, half a foot wide, and having a handle. The cotton was operated upon by these hand cards, so as to clean and straighten the fibres.

About 1747 Lewis Paul and Daniel Bourne both invented cylinder carding engines, which may be said to have originated the flat cards of to-day. There was a cylinder covered with cards working over a stationary curved surface, also covered with cards. The roller and clearer card was invented at a later date. The flat card was, therefore, invented before the roller and clearer, and after severe competition with the latter has again become the favourite.

In Lancashire, a few years later, Mr. Peel employed James Hargreaves to make a cylinder carding engine, and Arkwright, Lees and others assisted materially in perfecting the card, so that just prior to the invention of the mule by Samuel Crompton, in 1779, the card possessed almost all the principal essential features of the modern flat card. It was fed with a lap of cotton, and fitted with a doffer and doffer comb, these latter additions being attributed to Arkwright. In the Chadwick Museum at Bolton there is a card of Arkwright's time fitted with a number of top stationary flats. A similar card is at the Ashton Technical School.

At the beginning of the century just terminated David Cheetham, an employee of Mr. Tatham, of Rochdale, invented the coiler.

James Smith, of Deanstone, is credited with the original invention of the revolving flat card; and Evan Leigh, at a later date, with the invention of the flexible bend for the revolving flat.

Almost simultaneously with the invention of the flexible bend, George Wellman, of the U.S.A., invented the self-stripping motion for the stationary flat card.

During recent years some of the principal improvements have been the adoption of the *metallic taker-in*, the *dish feed*, and *hardened and tempered* steel wire, cylinder setting, slow motion grinding, larger doffers, improved grinding motions for the flats, slow motions for doffer, improved stripping combs and brushes for the flats, and many other improvements in detail have recently received more or less adoption.

Q. 1898. What is carding? Why is it necessary? What effect has it on the cotton? What defects (if any) arise in the cotton during the process?

A. Carding is the continuation of the opening out and cleaning of the cotton fibres, accompanied by the formation of a sliver in which the fibres are all in such a condition as to be easily reduced to parallel order in the subsequent processes.

It is necessary because there still remains a considerable proportion of fine impurities in the cotton, in addition to much short fibre, and because the fibres are entangled and crossed in every way in the lap.

Besides the desirable effects of disentangling, combing and cleaning of the cotton fibres, there are often the undesirable effects of scraping and weakening some of the fibres, and of cutting and nepping them sometimes. The web might be cloudy or contain slubs.

Q. 1897. What is a flexible bend in a carding engine? Describe and sketch two forms of bends, and say how each is set.

A. The flexible bend of a carding engine is the part upon which the ends of the flats traverse when in their working position over the cylinder. It was invented by Evan Leigh, and has been comparatively little altered in principle to the present time. It has now, however, several very formidable rivals for public favour, although it is probably more used than any other individual type at the present time. It consists of a plate curved on its upper or working surface, which is practically concentric with the surface of the cylinder, although raised a little above the latter in order to sustain the flats in a correct position. It has three to five setting points, which also act as supports or stays, although often only three points are used as setting points, and the other two merely as supports. The depth of this bend—which is fastened to the card side—is less at the ends than the middle, with the idea of its being compressed practically into a less circle when setting operations are performed, in order that the wire of the flats shall be maintained in concentricity with the wire of the cylinder. In setting, any one flat can be selected as a working example, and one or more flats taken off on either side of it, so as to allow for the insertion of a special gauge between the wire of the flats and that of the cylinder. According to this gauge the flexible bend is pulled down by the adjusting screws until the flats and cylinder are sufficiently close to each other, the distance usually being from $\frac{5}{1000}$ to $\frac{10}{1000}$ of an inch. The setting flat can be turned round to allow of each setting screw being properly adjusted. This type of bend possesses two disadvantages especially, which have led to various other styles being adopted with a greater or less degree of success. These defects are a great number of setting points and a tendency to lose concentricity. Messrs. Dobson & Barlow, of Bolton, for instance, make, when required, the "Simplex card," in which the bend has five pins firmly fixed to it. Three of these rest upon specially curved brackets, which are practically non-adjusting, secured to the card side. The pin at one end of the flexible bend is secured to a small crank, and at the other end passes inside brackets, which keep it in position. At this end is formed a toothed or rack part, with which engages a very small pinion. On the same stud as the rack pinion is a worm wheel, which is marked on its face into minute divisions with a pointer finger, and has engaging with it a small worm. The worm is carried by a stud which can be turned so as to give motion to the worm wheel, and thence by means of the small pinion the flexible bend is pulled slightly down all the inclined brackets, and the setting of one side of the card is thus performed all at one operation.

The use of this setting arrangement is optional with the buyer, and the same firm make also an admirable card with five independent setting points. In Figs. 43 to 47 inclusive will be found two well-known setting arrangements.

Q. 1899. Describe and give a sketch of (1) a flat used in a revolving flat card; (2) a flexible bend, showing the method of setting. What is the procedure adopted in setting the flats so as to ascertain that it is correct?

A. (1) There may be upwards of 108 flats in a modern carding engine, each flat extending across the width of the card, and resting on the flexible bend when the latter is used. Each flat may be $1\frac{3}{8}$ in. wide over all and $\frac{7}{8}$ in. on the wire, and is composed of an iron casting of rigid section, to which is securely fastened a strip of card clothing. Special clips are now extensively used in fastening the clothing upon the flat.

(2) As regards the flexible bend, this is the part upon which the flats slowly move, and is secured to the rigid bend or framing of the card by special adjustment, screws and brackets. To set the flats a special setting flat may be selected, and the flat on each side of it taken out to allow of the insertion of the gauge. The latter may be, say, $\frac{7}{1000}$ in. or $\frac{10}{1000}$ in., and, being inserted between the wire of the cylinder and flats, the latter are lowered until the gauge can be just got between the wires of the cylinder and flats. This may be done in turn for all the three or five setting places of the flats. Besides using the gauges to ascertain the accuracy of the setting, the cylinder may be turned, while the operator listens for any possible rubbing. A rough idea of the setting may be obtained by pressing nicely with the hand on the middle of the flats, but with very closely set flats care must be taken not to press too heavily.

Slotted Flexible Bends.

Messrs. Platt Brothers have now for some years made their flat cards with patent perforated flexible bends, as shown in Figs. 43, 44 and 45.

As stated before, in other cases it is customary to set the flats by sound or by touch, or by taking off two or three flats from the top and turning the flats to the setting points upon the cylinder, and then testing by gauge. Most practical men still prefer these methods, and obtain excellent results thereby.

There can be no doubt, however, that in many cases the senses of hearing and touch are more or less defective, and

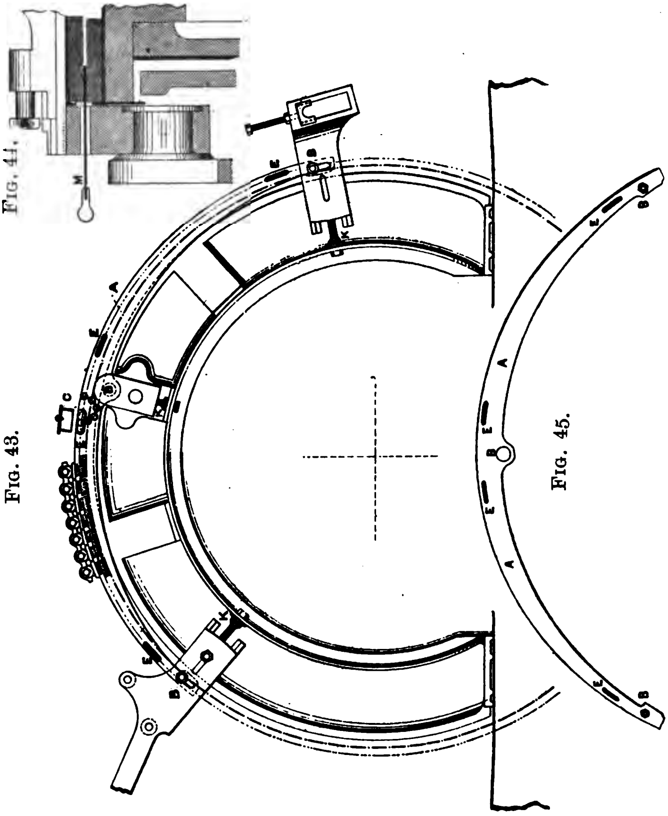


Fig. 44.

Fig. 43.

Fig. 45.

Figs. 43, 44 and 45

the use of the gauge in the manner indicated takes up a good deal of time.

In the slotted flexibles under notice a successful attempt has been made to more or less overcome these difficulties, and master, manager or carder can readily test the setting of the flats by gauge without flats being taken out.

Fig. 43 shows the elevation of those portions of the carding engine necessary to illustrate this invention.

Fig. 44 is a cross section of one of the perforations, and Fig. 45 shows the slotted flexible bend detached from the card. It is contended that this bend suffers no diminution of strength, as the slots are cast in them, thus preserving the natural surface or skin of the metal unbroken, and thereby maintaining its rigidity.

The flexible bend, A, is shown as usual with three setting points, B, and at E the slots are shown. C shows one of the solid plugs and chain attachment by which the perforations are closed when the setting is completed, and thus the holes are always closed during working.

When the flexible bend, A, requires adjustment it is only necessary to turn the screws, K, with the special screw key, and simultaneously inserting the steel gauge, M, in the slot nearest to it. The gauge, M, will easily pass between the wires on the flat and cylinder, as shown in Fig. 44 in cross section. Starting at the top or centre the attendant will in turn proceed to each setting screw and its adjacent perforation, taking care to use a gauge of suitable thickness for the class of cotton and the weight of lap he is carding.

This system is certainly simple and speedy, and it is contended by the makers that the flats are so rigid that setting well at the ends of the flats will ensure also correct setting in the middle of the flat, although it should be stated that some practical men contend that in many cases this would not be so.

Messrs. Howard & Bullough's Setting Arrangement.

Figs. 46 and 47 represent section and plan of patent setting arrangement for flats:—

A Index Nut which bears against outside of rigid Bend, D.
B Setting Key with fluted teeth which gear into the teeth on Nut, C.
C Toothed steel Nut which bears against the inside of rigid Bend, D.
D Rigid conical Bend which is moved in or out, and supports the flexible top bend throughout its entire course.
E Flexible conical Bend which rests on D and carries the Flats.

METHOD OF SETTING FLATS.

As the index nuts, A, and the toothed nuts, C, are turned one way or the other, they move the rigid bend, D, in or out, and thereby raise or lower the corresponding flexible bend, E, which rests upon it.

As the flats rest upon the flexible bend, E, they are raised or lowered with it. Each mark or division on index nuts, A, represents $\frac{1}{1000}$ part of an inch, and by turning the nuts the distance of a division the flats are raised or lowered to this extent.

The adjustment of the flats to the cylinder is rendered easy and certain—the dials are in full view of the carder, and he can see exactly how much he has lowered or raised the flats.

With this system of bend the flats may, if desired, be set further away at the back, and gradually brought nearer to the cylinder towards the front of the machine.

Having adjusted the flats correctly at any one point, the carder has only to notice the position of the index nut and set the rest of them to the same number, the work of a few seconds.

The adjustment of the flats cannot be tampered with by any unauthorised person, as a special key, B (Fig. 47), is required for the purpose. The method of adjustment will be clear from the appended illustrations (Figs. 46, 47 and 48).

A screwed stud is fixed firmly into the sides of the card, and carries at its outer extremity a graduating index nut, A, which rests in contact with the outer face of the lower ring, D. Upon the centre part of the stud is threaded a nut, C, which bears against the inner face of the lower ring, D, and which has teeth formed on its periphery as shown. Provision is made for the insertion of a suitable key, B, having teeth formed upon it, which gear with those on the nut, C. It will be understood that the adjustment of the ring, D, is effected by means of the nut, A, the wheel nut, C, constituting a locking device. It will also be noticed that, owing to the mechanical advantage which is obtained by the handle, B, and the geared nut, C, it is possible—when once the flexible bend has been adjusted—to very effectually lock the nut, A, in position. It will be seen the arrangement is self-contained, independent of outer brackets, and not liable to spring, and so affect the correctness of the adjustment of the flats. Moreover, this mode of setting allows of the card sides being turned and polished, thus greatly improving the appearance and facilitating the cleaning of the machine.

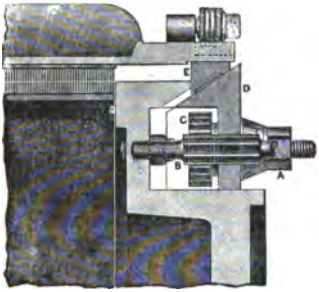


FIG. 46.

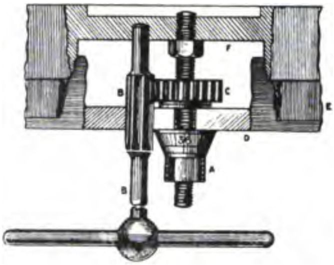


FIG. 47.

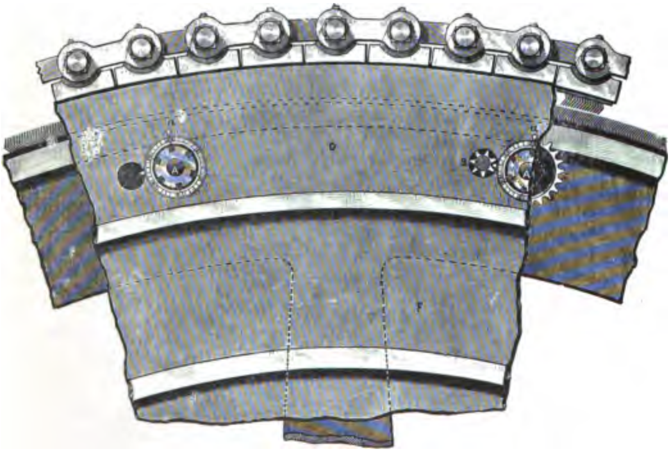


FIG. 48.

The five adjustable index nuts, referred to in the foregoing, are lettered A in Fig. 48, the letter B indicating the small holes for receiving the pinion-ended key, which is also marked B.

Setting places are easy of access, there being no wheels, straps or covers to remove.

PATENT ELECTRICAL TESTING APPARATUS.

For ensuring perfect accuracy of bends and flats with the foregoing setting arrangement when erecting the cards, the true position of the pedestals and cylinder axis is ascertained by what may be termed a patent electrical testing scriber.

ROLLER AND CLEARER CARDING.

Q. 1898. Describe shortly the construction of a roller and clearer carding machine, tracing the course of the cotton through it.

A. In a roller and clearer carding engine the lap is slowly unrolled and passed between the feed roller and the feed or dish plate.

The lap may thus be unrolled at perhaps eight or nine inches per minute, and is struck downwards from the feed plate by the taker-in, which may have a surface speed of about 800 feet per minute, with its strong saw teeth inclined in the direction of its revolution.

From the taker-in the cylinder takes the cotton in an upward direction, its surface speed being about 1,600 feet per minute, and its card teeth much more numerous than the teeth of the taker-in, and being inclined in the direction of motion.

Instead of the cotton being now acted upon by a number of flats, as in a flat card, it is acted upon by from five to seven pairs of rollers and clearers, each pair, however, being similar in action to all the others. These assist in the opening and cleaning of the cotton, but before reaching the first pair the cotton usually passes one or two more slowly revolving rollers, termed dirt rollers.

The dirt roller is usually fitted with an automatic stripping comb, which cleans it of the motes, leaf and fibre gathered from the cylinder. After the dirt roller the cylinder carries the cotton beyond the first clearer to the first roller.

This roller may have a surface speed of twenty or more feet per minute, and its teeth are inclined against those of the cylinder. Any tufts or entanglements of fibres are liable to be caught by the teeth of the roller and combed out, or otherwise transferred to the roller. Such fibres as are taken round by the roller will be probably taken off by the clearer, owing to the teeth of the latter having a surface speed of about 400 feet per minute, and the teeth being inclined so as to allow of this action. Such fibres are in turn swept off the clearer by the cylinder in exactly the same way that the clearer strips the roller, all the parts being set sufficiently close to allow of these operations. Practically the same action takes place at each subsequent pair of rollers and clearers. Sometimes the same portion of cotton may be acted upon by successive pairs of rollers and clearers, while some other portions of cotton may pass along without being acted upon by any of the rollers and clearers.

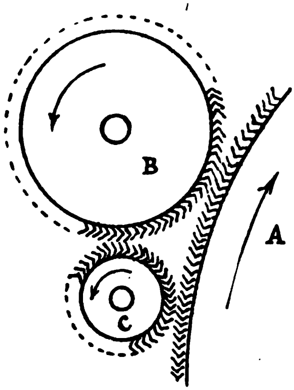


FIG. 49.

After passing the last pair of rollers and clearers the cotton is taken from the cylinders by the doffer, this being effected by the doffer teeth being inclined against those of the cylinder, by the surface speed of the doffer reaching only about seventy feet per minute, and by the doffer containing rather more wire points per square inch than the cylinders.

The doffer comb strips the doffer, after which the cotton passes through the trumpet tube, the calender rollers, the coiler top rollers and into the can.

Some twenty years ago it is probable that for medium counts the roller and clearer card—either double or single—was the most favourite form. At the time of writing this book it is seldom, if ever, that these cards are made for any counts of ordinary cotton spinning, although roller carding is the common practice in cotton waste spinning.

Manual labour is always necessary for the stripping and grinding of the rollers and clearers, and to do this work the card must always be stopped.

In Fig. 49, A is a portion of the cylinder, B is the worker or roller, and C is the clearer. Three points require special attention on the part of students, *viz.*, (1) the inclination of the wire teeth of each part, A, B, C; (2) the direction of revolution of each part; (3) the surface speed of each part as above given.

It will be understood that the dirt roller comes before the first clearer, C, and that there would be five or six pairs of rollers and clearers to follow, B, C, but the action of each pair is identically the same as the others.

Q. 1897. What are the cleaning organs in carding engines of the two principal types, and how do they perform their work?

A. The chief cleaning organs, as regards the heavier impurities, in either the roller and clearer card or the revolving flat card, are the metallic taker-in, in conjunction with the dish feed. These are immeasurably superior—at any rate, in our opinion—to the old style of a pair of feed rollers and a taker-in with a leather foundation to the wire. In any case the vast bulk of the heavier impurities should be found beneath the taker-in, the mote knives playing an important part in their extraction. There should not, however, be found at this point much short fibre, as the rollers and clearers in the one case, and the flats in the other case, are the chief factors for the extraction of these. In the latter case the short fibres are driven by centrifugal force from the cylinder, and, being retained by the flat teeth, are stripped therefrom chiefly by the stripping comb, so that they fall upon the covering of the doffer at the front of the card. The cleansing of the flats is further carried out by the stripping brush, so that clean flats always pass to the back of the card. In the roller and clearer card there is often a dirt roller revolving at a slow rate, and having somewhat coarse wire on, which takes out a fair proportion of short fibre and leaf, motes, etc. After the dirt roller, the cotton passes beneath the first clearer, whose teeth are set the same way as those of the cylinder, and because the latter makes about 1,600 feet surface speed per minute against 400 for the clearer the latter cannot retain the cotton. The roller has its teeth set against those of the cylinder, and has a surface speed of only about twenty feet per minute, and a fair proportion of the uncombed fibres are retained by the roller, and for the most stripped by the clearer and returned to the cylinder. Short fibres are to some extent retained by the rollers and afterwards stripped out, but it does not appear that this card takes fibres out so effectively as the flat card.

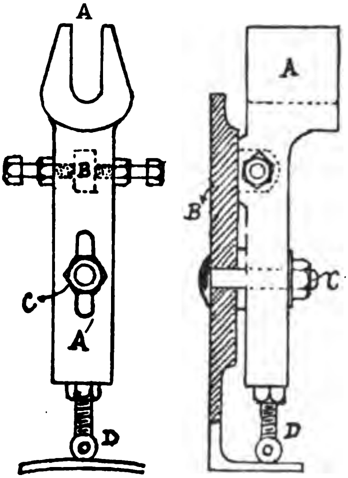


FIG. 50.

Q. In setting the roller and clearer card, is the roller or clearer moved when it is desired to widen the space between them? What is the arrangement by which each is brought nearer the cylinder as the wire wears down?

A. Two views of a roller stand are given in Fig. 50. The roller end is supported at A. To set the roller, A is loosened at the slot, C. By means of the vertical screw, D, the roller is adjusted vertically, and by means of the horizontal screw, B, it is set closer to or further from the clearer. The clearer has a screw like D, but not one like B.

It is not necessary to provide means for adjusting both the roller and the clearer to each other, and, as a rule, each roller bracket or pedestal only is provided with an adjusting screw, by which the distance between the roller and clearer may be increased or diminished at will.

All the brackets or pedestals upon which the rollers and clearers are supported are provided with adjusting drag-screws, which pass through the cylinder framing; and by means of these drag-screws the rollers and clearers can readily be drawn nearer to or further from the cylinder.

Q. Sketch and describe the arrangement of the feed roller, licker-in and mote knives of a carding engine, indicating the way in which the cotton is delivered to the cylinder from the lap.

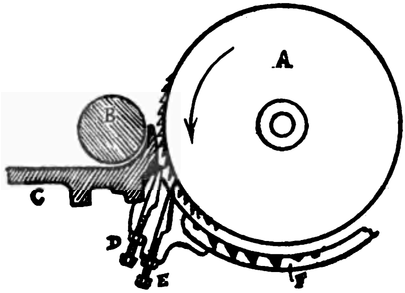


FIG. 51.

Referring to Fig. 51:—

A represents the Taker-in.
B is the Feed Roller.
C is the Feed Plate.
D and E are the Mote Knives.
F is the undercasing to the Licker-in.

A. Formerly there were two feed rollers very generally employed on a carding engine. The position of the bottom-feed roller is now usually filled by what is termed the dish-feed plate. This is curved so as to be practically concentric with the top feed-roller just where the two are in close juxtaposition. The great advantage of this method is that the cotton is held by the feed roller and feed plate much closer to where it is struck down by the taker-in, and is much better combed and much less liable to be struck down in lumps. The face of the feed plate may be made longer for long stapled cotton than for short cotton. Leaving the feed portion the cotton comes to one or two mote knives, as the case may be. These are adjustable, and serve to catch any portions of seed, leaf, etc., that may be on the licker-in teeth. The mote knives are usually combined with the licker-in undercasing, at which the cotton next arrives, and which may contain four to seven bars. The undercasing allows of the dropping of short loosened fibres. If set too close this undercasing may allow short fibres to pass forward, while if set too far away it may allow good fibres to fall out.

The cotton is delivered to the cylinder in a very open condition, with the fibres freed from much of the heavier dirt that had previously escaped the scutching processes. The relative surface speeds of the feed roller and cylinder are such that there is scarcely one fibre of cotton per individual tooth on the cylinder.

Q. 1899. Upon what principles are the setting and shaping of the feed rollers, pedal nose or dish feed in scutching and carding engines based? What happens if they are wrongly set or shaped? Give sketches.

A. Formerly it was the general practice to have a pair of feed-rollers, one placed over the other. With these it was difficult to get the cotton efficiently combed and taken forward in a uniform manner by the licker-in teeth, on account of the distance of the vertical centres of the rollers from the striking point of the teeth. It has now become the very general practice to use only the top-feed roller, and to place underneath it the concave portion of a feed plate, concentric with the feed roller. By this means the cotton can be held much nearer to the licker-in teeth, and the setting distance can be regulated to the length of staple. The face of the feed plate is often made longer for long cotton than for short. If the feed plate is wrongly set or shaped there may be too much good fibre taken out, or too small an amount of short fibre, leaf, seed, etc. There may be also a tendency to damage the fibre and to take it forward irregularly.

It will be noticed that the face of the feed plate next to the taker-in, C′, is longer for long staple cottons than for short staple, this being done in order to bring the dotted

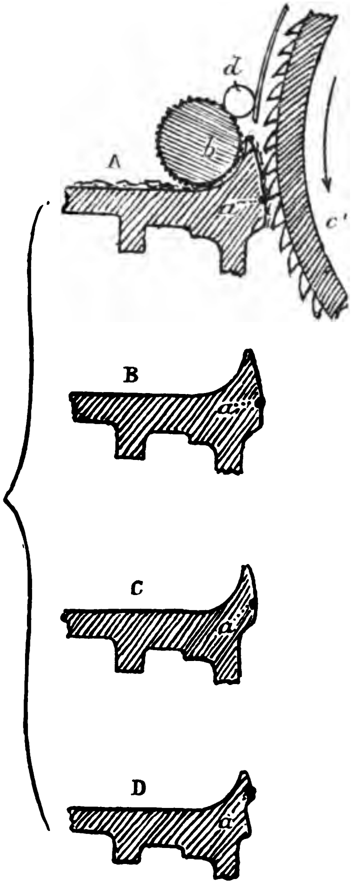


Fig. 52.

FEED PLATE.

The Feed Plate for Sea Islands is shown at A.
,, Egyptian ,, B.
,, American ,, C.
,, Indian ,, D.

striking point, *a*, of the taker-in farther from the nip of the feed roller on the cotton for long than for short cottons.

Q. 1896. What is the purpose of the "heel" in the flats of revolving flat carding engines, how does it affect the carding, and how is it maintained throughout the life of a flat?

A. The front end of the flat, or the end farthest removed from the feed part of the card, is called the "heel," and is always somewhat nearer to the cylinder than the back or "toe" of the flat. A little reasoning will convince any one that this tilting up of the back edge of the flat must be a great advantage in carding the cotton. The fibres have by this arrangement great freedom to enter upon the flat without rolling up and nepping. As they are carried forward beneath the flat their free ends are combed down in approaching the heel. Without the "heeling" it is probable that we should have to set the flats bodily farther away from the cylinder than we now do in order to prevent rolling up of the fibres of cotton. This, of course, would be a distinct disadvantage.

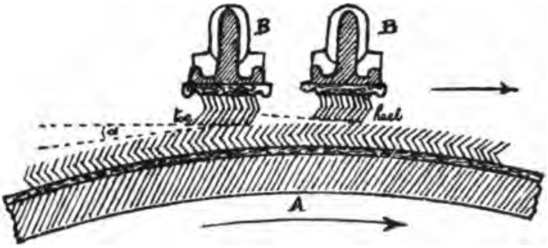


FIG. 52 (*a*).

Although it is comparatively easy to put the heel into the flats when the card is new, it has been found a matter of some difficulty to efficiently maintain it throughout the life of the card, as the systems of grinding the flats long used have tended to destroy it. Quite recently a number of devices have been patented and adopted to a greater or less extent, having for their object the grinding of the flats whilst their working surfaces are held firmly pressed against a bracket of suitable shape. By this means it is found that the heel can be very effectively maintained. This arrangement provides in the grinding for the unequal wear which sometimes takes place in the ends of the flats. Perhaps the most largely adopted of these motions is Higginson & M'Connell's patent, shown in Fig. 68.

In Fig. 52 (*a*) the cylinder is marked A, and B, B are two flats. The cotton passes beneath the flat at the toe, and leaves each flat at the heel or nearest part of the flat to the cylinder. In a flat of $1\frac{3}{8}$ in. width over all the heel may be approximately $\frac{1}{32}$ in. nearer the cylinder than the toe.

Q. What is the object of under-grids attached to carding engines? What are the effects if set too far from the cylinder, and if removed altogether?

A. For many years it was the practice to make carding engines without undercasings for the cylinder, and it was the author's experience that a large amount of good fibre found its way to the floor. Their real use is to prevent the emission of good fibre on the one hand, and on the other to prevent impurities that have reached the floor from again being picked up by the cylinder.

An undercasing may be described as a tinned iron grid which should be as smooth as possible, and fitted underneath it from the doffer to the taker-in.

Since the cylinder enters the undercasing from the front of the card the casing should be set from $\frac{1}{4}$ to $\frac{3}{8}$ in. away at the front, and, say, from $\frac{17}{1000}$ in. to $\frac{22}{1000}$ in. away at the back.

Removing the undercasings, or setting them too far away, leads to waste of good fibre. At the same time either procedure would tend to cause accumulations of fibre which would be picked up in pieces and taken round by the cylinder.

It may be noted that actual experience demonstrates that all the good fibre is not promptly transferred from the cylinder to the doffer as might be at first imagined.

Q. 1899. What is the construction of the undercasings of a carding engine? How are they set? If you know of any special arrangement to facilitate setting, describe and sketch it.

A. In a general way it may be said that the undercasings of a carding engine are practically two, the first being placed beneath the taker-in, and the second underneath the cylinder. These undercasings should be concentric with the taker-in and cylinder respectively, and their use prevents the falling out of too much fibre. They may be joined up to each other.

One or two mote knives are often used in connection with the taker-in undercasing, and may be independently adjusted for height. Their use facilitates the removal of seed, leaf and various impurities. In some cases a special method of setting is utilised by which several of the initial parts of the machine, such as the feed plate, mote knives and undercasings, can be simultaneously and readily adjusted.

Q. 1900. At what speed do the flats of a carding engine move, and in which direction? How do they affect the cotton in its passage? How are they driven?

A. There is no fixed standard speed for flats, but it is always a slow speed, and extreme limits may be taken at from one inch per minute to about six inches per minute. The slow speeds are used when a less amount of strips are taken out, and the quicker speeds when a greater amount of strips are required to be taken out. About three or three and a half inches per minute may be taken as a fair average speed for the flats. Although attempts have been made to have the flats with their working surfaces revolving against that of the cylinder, they have not been successful, and it is the general practice to have contact surfaces of the cylinder and flats revolving in the same direction.

The action of the flats is to resist the forward motion of the cotton fibres on the teeth of the cylinder, thus exercising a combing and cleaning action on the fibres. Many of the fibres, and a good portion of the leaf, etc., are retained by the teeth of the flats, and come to the front of the card as flat strippings.

As regards the driving of the flats, a common arrangement is to have a small pulley on the offside of the cylinder driving a somewhat larger stud pulley. On the same stud is a single worm driving a small worm wheel on a short shaft. On the same shaft is a second worm driving a second and larger worm wheel. On the same axis as this second worm wheel is the flats chain pulley, on which the flats rest, and by the slow revolution of which they are pulled round.

In Fig. 53, A is the doffer, B the licker-in, and C the cylinder. From the pulley, D, on the cylinder the flats pulley, E, is driven by a belt. F is a single worm driving the worm wheel, G. At the other end of the short shaft is a second worm, H, giving motion to the second worm wheel, I.

On the same stud as I is the flats chain or star wheel, which pulls the flats round by linking between them.

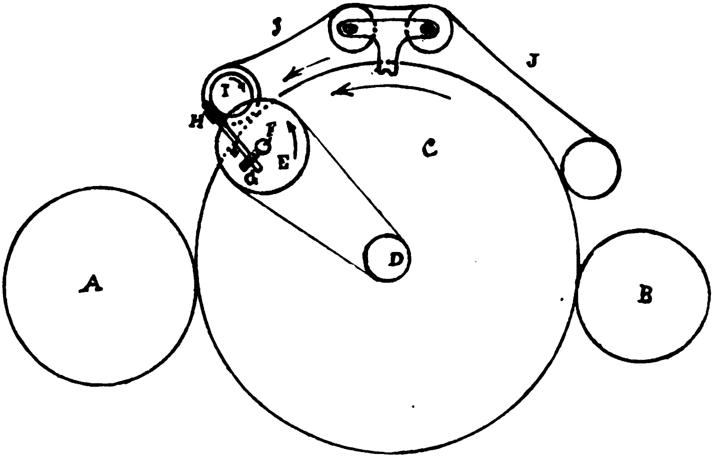


Fig. 53.

Card Clothing.

Q. Briefly describe how the clothing is attached to the flats.

A. This work has to be done at the machine shop, because

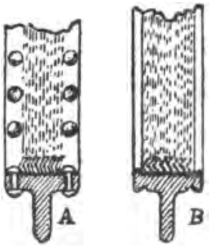


Fig. 54.

of the need of special tools, etc. There are several ways of doing this work. Formerly a very common method was to drill holes in the iron flat and to rivet the clothing to the flat; but this plan has almost fallen into disuse, partly owing to its weakening the flat and not holding the cloth down between the rivets.

Another method is stitching the clothing on with wire, or else fastening in a manner much resembling stitching by flattened wire clasps.

The latest and most favourite method is to fasten the clothing by specially devised clamp fasteners, of which Tweedale's and Ashworth's are well-known makes. In the sketch (Fig. 54) the riveting method is shown at A and the clamp fastening at B.

Q. 1900. Describe and sketch the different ways in which the teeth of card clothing are set in the fillet (*a*) looking at the back; (*b*) looking at the edge. What is the object aimed at in each case?

A. As is well known the teeth inserted in the card clothing are always inserted in pairs, and the part uniting two teeth is called the "crown". The working end of each tooth is termed the "point," and that part of the tooth near the middle, where it is bent, is appropriately termed the "knee". (*a*) Looking at the back of the "foundation" we see the "crowns," and, according to the particular disposition of these "crowns," and consequently of the teeth, the arrangement is said to be "plain," "ribbed" or "twilled". The two latter are the most used, and the "ribbed" arrangement appears to be most used for cylinders and doffers. (*b*) Looking at the edge of the fillet it will be seen that the teeth are always bent at a point not far removed from the middle. This angle is necessary in order to give carrying power to the wires, and it enables the wire also to lend itself more readily to the purposes of stripping and grinding; and, again, it facilitates the transference of the fibres from one organ to another. In arranging the teeth the object aimed at should be to distribute them as uniformly as possible all over the surface without overcrowding the teeth in one part or leaving empty spaces in another.

Q. 1898. Describe and sketch the disposition of the teeth in card clothing for various purposes. What is meant by "foundation," "crown" and "knee"? Indicate on your sketch.

A. The saw teeth of the licker-in are inclined in the direction of its revolution.

The teeth of the cylinder are also inclined in the direction of its revolution.

The teeth of the flats and of the doffer are inclined against those of the cylinder and against their own direction of revolution, and the same remark holds good for the teeth of the roller of a roller and clearer card. The teeth of the clearer are inclined in the same direction as it revolves in.

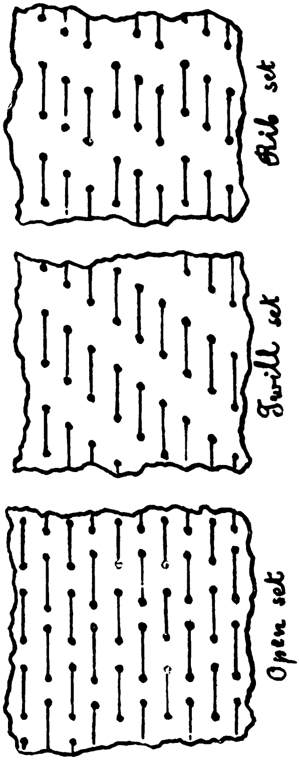
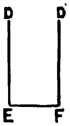


FIG. 55.

The foundation is the material in which the card teeth are fastened. It may be formed of layers of woollen cloth with cotton cloth sandwiched between them and the whole cemented together, so as to form a very strong foundation for the wire teeth, while at the same time allowing the teeth a certain amount of elasticity. For cylinders and doffers the foundation is often composed of a layer of rubber cemented upon a cloth bottom, as this gives additional elasticity to the teeth. The "crown" is the cross bar which couples two wire teeth together, and is at the back of the foundation. The "knee" is the corner of the tooth where it is bent.



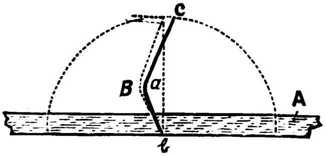


FIG. 56.

Figs. 55, 56 and 57 are intended to give an idea of the points under discussion in this and related questions. Fig. 55 shows the back of the clothing. It must be remembered that the teeth are made in pairs, united at the back, as shown at D, E, F, where E, F is the crown and D, D′ the points or prongs. While middle bend of the teeth is sometimes used for waste cards, for ordinary cotton cards it is customary to have the knee or bend of the tooth a little below the middle. A (Fig. 56) is the foundation of the clothing, B is the knee and C the point, while the "keen" of the tooth is the amount of inclination of the tooth. Magnified views of wire teeth are shown in Fig. 57. At C is the plough ground wire, which is probably the most used. B is the triangular pointed tooth which is used to only a comparatively moderate

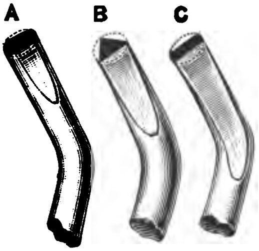


FIG. 57.

extent. A shows a sort of half-way point between needle point and plough ground.

Q. 1896. With what kind of clothing would you cover the cylinders, doffers and flats respectively of a carding engine for carding either middling American or Egyptian cotton? State (1) the class of foundation; (2) the kind of wire; and (3) the counts used. Give your reasons and say which cotton you select.

A. We will take the American cotton as being the typical example. As regards foundation, there are three chief varieties in use, *viz.*, cotton woollen cotton, cotton, and indiarubber, or, at least, a thin layer of rubber spread on a cloth foundation. The object of using rubber is to secure a foundation of sufficient firmness and yet possessing considerable elasticity, so as to allow of the wire springing back into its original position whenever it has been deflected by a grinding roller or by other means. The worst of the rubber is that it is susceptible to climatic influences, which in time seriously impair the original excellent properties of the rubber. A very favourite foundation is the cotton woollen cotton, which is composed of two layers of cotton cloth specially woven with a layer of woollen cloth cemented between them. It is possessed of a fair amount of elasticity in combination with good lasting properties. As regards the kind of wire, the mild wire formerly employed has given way to hardened and tempered steel wire, which only requires grinding at intervals of considerable length, whereas the mild wire required grinding twice a week. Needle-pointed wire, closely set, would be the best shape of tooth obtainable, but, although it could be inserted into the foundation at first, this shape of tooth could not be maintained by any system of grinding in use. Various shapes of teeth are employed, such as triangular, double convex, and oblong. A form of tooth in favour is the plough ground, which gives a fine chisel point closely approximating to the needle point, although by side grinding there is a danger of scratching the sides of the teeth and barbing the points. As regards counts of wire there is some amount of variation, but it may be taken that 110's for the cylinder and 120's for doffer and flats is a fair average.

Q. Give counts of wire suitable for different cottons for cylinder, doffer and flats.

A. An eminent firm of machinists quotes the following as a suitable list:—

	Cylinder.	Doffer.	Flats or Tops.
For Surat—Lowest class	80's	90's	70's
,, ,, Better ,,	90's	100's	80's
American—Lowest ,,	100's	110's	100's
,, Better ,,	110's	120's	110's
Egyptian—Ordinary ,,	110's	120's	110's
,, Better ,,	120's	130's	120's

It will be noticed that the cylinder and flats take the same counts, while the doffer is 10 counts finer.

Q. What is meant by the "counts of wire," and what is the basis for this numbering?

A. The present method of denoting the counts of wire does not appear to be sufficiently clear, and many people have at first imagined that it meant the points per square inch.

The counts of wire, as a rule, really may be taken to equal the points per square inch divided by 5.

To put it the other way, the counts × 5 would equal the points per square inch.

This practice appears to be based on the method which obtained when the old sheets of four inches standard width were in common use. The wires then, as they are now, were inserted in pairs, two wire teeth, or "points," being connected by the "crown" at the back of the clothing. 120's counts of wire, for instance, meant 120 crowns in the 4 in. width of sheet. A standard of 10 crowns per inch of length was taken, thus giving 120 × 10 crowns in four square inches. 1,200 × 2 gives 2,400 points in four square inches, which divides out to 600 points per square inch. The short rule of counts × 5 would give the same result of 600, and is based on, and obtained from, the above figures by a simple cancelling process. From actual examinations made by the author the rule does not appear to work out very exactly in many cases.

Q. 1899. Describe in detail the method of clothing a carding engine cylinder. What preparation of cylinder or fillet is made? What precautions are taken during clothing to avoid loose places, and how are they most likely to arise?

A. The clothing of a carding engine cylinder is an operation requiring care and experience. As regards the preparation of the fillet, it may be said that, owing to the foundation of cylinder fillet being often faced with rubber, it ought to be kept in a warm room for some time before application to prevent it from becoming slack and loose by expansion. In the preparation of the cylinder it has been more or less the practice to paint it, or to cover it with thin calico, to form a kind of bed to make the fillet lie better on the cylinder. It has now become common to apply the fillet to the smooth and bare surface of the cylinder. The cylinder has a number of rows of holes drilled into it and fitted with wooden pegs, to allow of tacks being driven into the pegs through the fillet. The latter is first fastened at one end and then wound spirally round the cylinder, being kept under a tension of about 270 lb. for hardened wire by a special apparatus. An important and special feature of the operation is the making of the tail ends so as to get the clothing flush up to the cylinder end with as little waste of wire as possible. After clothing the cylinder may be allowed to stand for some time before finishing the tacking process in order to bed itself, as it were, and to get a uniformity of tension all over the surface. The cylinder is very slowly rotated by hand during the clothing operation. Machines for clothing cards are shown in Vol. III. of this series.

Q. 1899. How is the doffer of a carding engine driven, and what is the effect of decreasing or increasing the speed? In what way is the cotton laid upon the doffer, and how is the latter stripped?

A. It is now the common practice to drive the doffer from the licker-in, so that if the latter gets scotched the doffer and feed will also stop. For want of this little arrangement there were many bad messes formerly made by the feed rollers piling the cotton upon a stopped licker-in. A crossed belt, or an open belt, or a thin cord may be employed to drive the doffer. When the cord is used it simultaneously drives the doffer and licker-in. With a crossed belt the latter gives motion to the barrow pulley, and on the same stud is the barrow change wheel, which gears into and drives a large doffer end wheel, sometimes containing upwards of 180 to 200 teeth. If we increased the doffer speed the production from the machine would be increased in the same proportion, because all the feed and delivery parts of the card would move more quickly. The cleaning organs, *viz.*, the cylinder, flats and licker-in, would only go the same speed as before, and therefore the cotton would not be opened and cleaned as well as before. Decreasing the doffer speed of course would have the opposite effect. The cotton is laid on the doffer by the surface speed of the cylinder being about twenty-six times that of the doffer, and by the teeth of the doffer being set against those of the cylinder. This action tends to destroy the parallel order of the fibres. To strip the doffer the card is stopped and a circular brush is placed over the doffer so as to rest in proper brackets. The brush is set somewhat into the doffer teeth, and being rapidly rotated by a cord from the cylinder, while the doffer itself is slowly moved round, the loose fibre, dirt and dust in the doffer teeth are taken out. A minute or so should serve for doffer stripping.

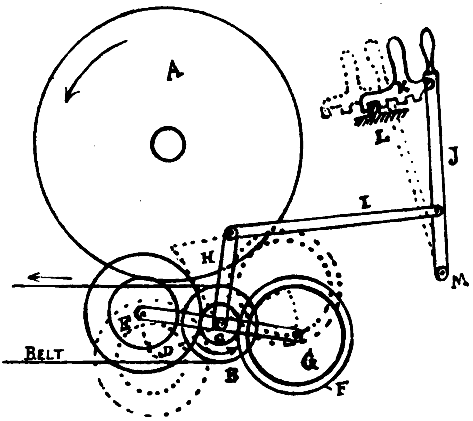


Fig. 58.

During working the cotton is stripped from the dofferby means of the doffer comb, which may make upwards of 1,500 to 2,000 strokes per minute.

Single and Double Speed of Doffer.

By means of the open belt shown (Fig. 58) motion is given from the taker-in to the barrow pulley, B. On same stud is the driving wheel, C, which gears both with wheel D and wheel F. On the same stud as D is wheel E, shown engaged with and driving the large doffer wheel, A, the engagement being maintained by the latch-lever, K, being latched, as shown on the stop, L. Suppose double speed were required, K would be unlatched, and by means of the handle lever, J, M, and connecting links, H, I, the whole set of wheels, B, C, D, E, F, G, and the studs, etc., would be moved to the left, so that wheel G would begin to drive the doffer wheel, A, at a much quicker rate than E. One use of this motion is to put high-speed doffers on the slow speed during piecing-up, etc. The motion described is made by Dobson & Barlow.

Q. 1900. How is the cylinder of a carding engine constructed and prepared for clothing? Describe and sketch the methods of constructing the bearings in which its axle revolves, and state what special objects are aimed at.

A. The special construction and preparation of the cylinder, done with a view to the operation of the clothing, is to drill several rows of holes across its width and to drive wooden plugs tightly into these holes, as shown in Fig. 59.

Extra holes are drilled round the edges of the cylinder for the tail ends and first layers. The filleting is secured to the cylinder by "tacks," which are driven into the wooden plugs. Formerly it was the practice to cover the surface of the cylinder with cotton cloth or other material to give a better bedding to the fillet, but it appears now to be the more common practice to wrap the fillet on the bare iron.

As regards the bearing of the cylinder, the most important development during recent years has been in the direction of providing not alone a good bearing surface, but also a bearing which should be capable of ready adjustment, in order to compensate for wear due to the pull of the strap and long working of the machine.

In this way it has been sought to place in the hands of practical men an additional means of maintaining perfect concentricity of the cylinder with the flats. Several makers have devised such arrangements, but so far as the writer can judge this cylinder adjustment idea has not taken with many people. In any case the pedestal should be constructed with a good long bearing, and be lined with some good material to resist wear, such as phosphor bronze. In Messrs. Dobson's cylinder adjustment there are two eccentric bushes, which can be altered as required to keep the cylinder concentric with the flats.

Fig. 59 should convey an idea of the construction of the cylinder, the peg holes being shown in the upper portion, while the covering is shown in the lower portion.

Fig. 60 shows one example of a cylinder bearing.

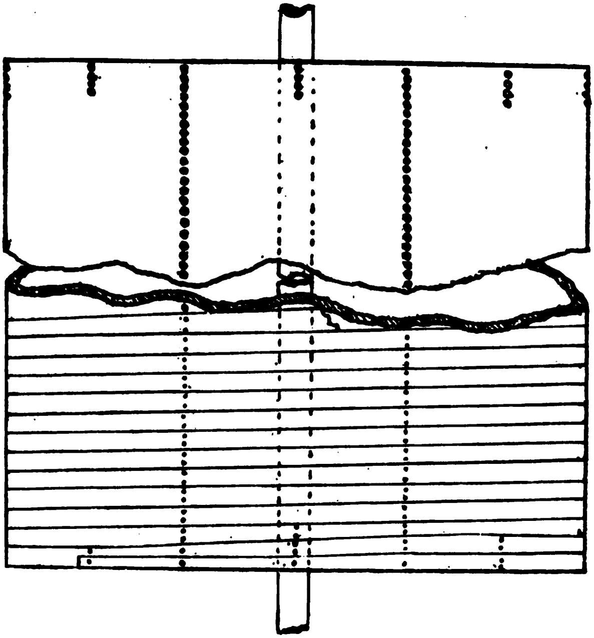


FIG. 59.

Cylinder Bearing.

In Fig. 60, A is the cylinder end surrounded by the bush, B. By screwing at F the incline at C will raise or lower the cylinder as required. By means of a screw, D, the cylinder may be adjusted laterally. E, G are the bolts which fasten the cylinder bearing to the framing. This figure is a lecture diagram, with some resemblance to Howard & Bullough's bearing.

Q. 1897. Sketch and describe the construction of a coiler head. How is it driven, and from what part of the carding engine?

A. All parts of the coiler are driven from a vertical shaft inside the coiler box, which is itself driven by bevel wheels from an extension of the calender rollers. At the coiler head there are two parts that require driving: (*a*) The plate wheel itself, carrying the oblique sliver tube, which is driven from a spur wheel on the upright shaft alluded to. (*b*) On the upper extremity of this shaft is a bevel wheel, which drives one of the coiler top rollers, and the second coiler top roller is driven from the first by small spur wheels. The sliver enters the coiler through a trumpet-shaped orifice at the top, and immediately passes through an inclined or obliquely disposed tube, formed in the plate wheel. This opening is such that the sliver passing through it is deposited in a series of coils, extending each of them from the edge of the can to a point just beyond the centre in such a manner as to leave an opening in the centre of the can extending from top to bottom. This is the usual and better plan, but in some cases each coil is extended only from the edge of the can to a point just short of the centre, by this means getting more cotton in the can, but greatly enhancing the danger of entanglement when the sliver is being withdrawn. The coiler bottom is usually driven at a very slow rate by a train of seven wheels,

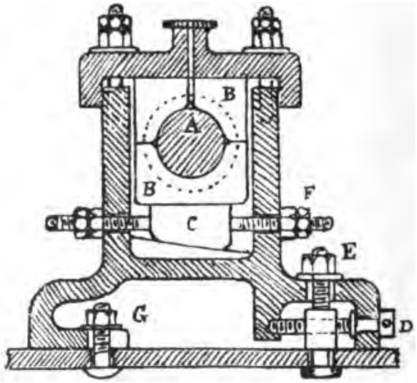
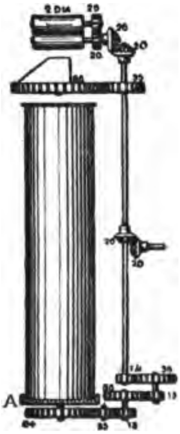


FIG. 60.

the first being on the bottom of the upright, and the last practically forming part of the coiler bottom plate.

The coiler motion is shown in Fig. 61. In this case motion is given to the upright shaft by the two 20's bevels at the middle of the shaft. The four wheels of twenty teeth each on top of the arrangement give motion to the coiler top rollers of 2 in. diameter. At the bottom is shown the driving of the can bottom wheel, A, by seven wheels. The 35 wheel next to the 84 is only a carrier used to give the right direction of motion to the can.



ELEVATION OF COILER GEARING

FIG. 61.

Q. 1898. The vertical shaft of a carding engine coiler has on its upper end a spur pinion with 25 teeth, driving the wheel on the tube plate with 75 teeth. On the lower end is a pinion with 15 teeth gearing into a double carrier pinion with 44 and 15 teeth respectively. The 15 pinion gears with a compound pinion also with 44 and 15 teeth, and the last-named 15 pinion gears with a carrier with 17 teeth, which drives the can plate wheel having 85 teeth. How many revolutions does the tube plate make for each of the can plate?

A. Probably the best way of working this question is to assume the can plate wheel as the driver of the whole arrangement and its speed at one revolution, and then find the revolution of the tube plate in the same time by the ordinary rule of speeds as follows:—

$$\frac{1 \times 85 \times 44 \times 44 \times 25}{15 \times 15 \times 15 \times 75} = 16{\cdot}24.$$

Or we might assume the vertical shaft to make a certain number of revolutions per minute, say 100, and proceed as follows:—

(*a*) $\frac{100 \times 25}{75} = 33{\cdot}3$ = revolutions of the tube wheel.

(*b*) $\frac{100 \times 15 \times 15 \times 15}{44 \times 44 \times 85} = 2{\cdot}0509$ = revolutions of can wheel in same time.

(*c*) $33{\cdot}3333 \div 2{\cdot}0509 = 16{\cdot}24$ = revolutions of tube wheel to one of can wheel as before.

Q. 1897. Describe the doffing comb mechanism of a carding engine, and say what its usual speed is. Sketch the method of drying the comb.

A. The comb-box of a carding engine is one of those parts which have demanded considerable attention on the part of machinists at one time or another. We have personally had to do with comb-boxes, which could not be kept right, despite every possible attention. If they were kept filled with oil the latter would be thrown out upon the cotton, the wire and the floor in a rapid and damaging style. If they were not kept well filled with oil they would shortly get too hot for anything. The doffing comb mechanism might be said to consist of three parts, *viz.*, the comb itself, the comb-box and the driving pulleys and cords. The comb itself, which may make about 1,600 strokes per minute or more, is a steel bar connected by arms to a shaft which is made to vibrate by an eccentric in the comb-box. The motion is obtained by a large cord pulley on the cylinder shaft driving a small pulley on a stud not far from the floor. On the same shaft is another pulley from which a cord extends upwards to a small pulley extending outward from the comb-box. The double system of pulleys gives the requisite increase of revolutions, starting at about 180 per minute with the cylinder.

A neat and effective arrangement of comb-box is shown at Fig. 62 as made by Dobson & Barlow. The quick rotation of the pulley shaft, C, actuates the eccentric, E, and thus rapidly oscillates the eccentric bush, F. B, A, F is practically a bell-crank lever, with the fulcrum at A, the doffer comb at B, and the eccentric bush, F, being on the other arm. Clearly the rotation of the eccentric, C, will give a quick oscillation to the comb, B. The motion inside the box revolves in a bath of oil as shown. The comb-box is held down by the bolts, G, I, and is adjustable by the setting screw at H, so as to bring the comb nearer to or farther from the doffer.

Doffer Comb-Box.

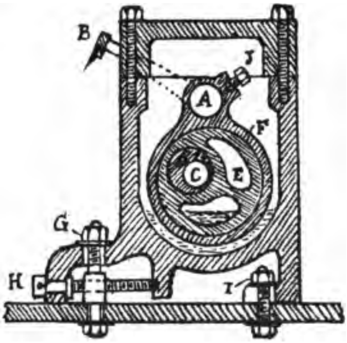


Fig. 62.

Q. 1897. Describe a Horsfall grinding roller and the method of applying it to grind the clothing of the cylinder and doffer of a carding engine. What parts would you remove to perform the operation?

A. The Horsfall grinding roller is a most ingenious and successful apparatus for enabling grinding to be performed to some extent at the sides of the card teeth instead of all at the back. The grinding portion itself is a narrow disc covered with emery, and having a compound or double movement. It rests upon a tubular roller, inside of which extends a rapidly revolving screw cut both right and left. The tubular roller has a slot extending almost its whole length, and a fork projects from the grinding disc through the slot in the shell or tube and into the groove of the screw. By this means the disc is made to revolve, and also to travel continually, from one end of the tubular roller to the other. The rotary motion is obtained simply by the slot in the tubular roller carrying the disc round, and the difference in revolutions per minute between the roller and the screw, combined with the pitch of the latter, represent the lateral traverse.

In grinding the cylinder and doffer, we must, first of all, run the card bare. We have seen a few messes made by forgetfulness of this important point. The front cover or door of the cylinder, and the same for the doffer, must be turned over. The cylinder must have its belt turned so as to revolve the cylinder the opposite way during grinding, in order to get the grinding done at the back and sides of the teeth, and to more readily get a sufficient difference in surface speed between the grinding roller and the wire. In fast grinding the cylinder belt will be on the fast pulley, but in slow grinding it will be on the loose pulley, and the cylinder will be driven by a slow motion, which reduces its speed to probably six or seven per minute instead of 180. A great deal has been made of this slow motion grinding in recent years, and almost every machine firm has brought out an arrangement for economically and readily carrying out. Our own experience and observation all go to demonstrate that there is really very little regard paid to it by the greater number of practical men, at any rate in a great many cases.

Fig. 63 shows the Horsfall. A is the shell or tube; B is the traversing emery covered Horsfall grinder; C is the double screw cut so to allow the tongue, F, to penetrate it and to work either one way or the other. The tongue, F, protrudes right through the groove of the shell, A, into the screw, C. Rapid rotary motion is given to the emery roller, B, from the shell, A, operated by the grooved rope pulley, E. The screw, C, is also quickly rotated by the pulley, D, and gives lateral motion to the tongue, E, and the emery roller, B.

It must be distinctly understood that the quickness of the lateral traverse of the emery disc depends upon the difference in revolutions per minute between the shell, A, and the screw, C. Dobson & Barlow make an improved grinding Horsfall, in which the emery roller has a quicker lateral motion at the centre of the cylinder than the ends.

Q. 1900. How are the cylinders and doffers of the carding engine ground? What is the relative speed of the grinding roller, and how should it be supplied? What happens if it is improperly used?

A. In grinding the cylinders and doffers the card is run quite bare, and then the cylinder is reversed in direction.

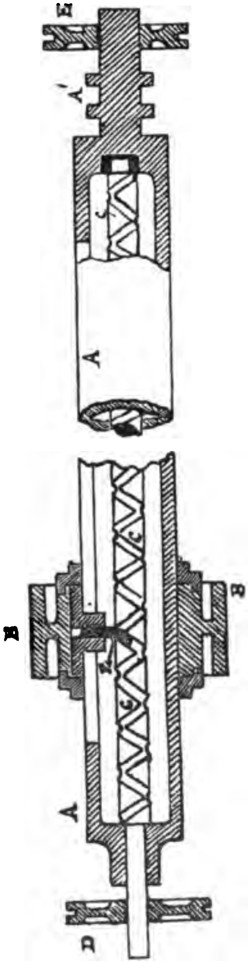


FIG. 63.

The doffer is allowed to run in its working direction, but its speed is very greatly increased, to approximately about the same surface speed as the cylinder. The grinding rollers are of two types—first, the Horsfall; second, the so-called "dead" roller or full-length roller. The Horsfall is the more accurate grinder, but the dead roller is the quicker one. Both rollers have a lateral traverse, with the object of getting to the sides of the teeth better. Grinding is done mostly on the back of the teeth, and never on the front of the teeth. The grinding roller may revolve approximately at about one-third to one-half the surface speed of the cylinder and doffer, and the revolution of the grinder is in the opposite direction to these parts. The grinding roller should be applied as equally as possible all across the width of the card. Improper and careless grinding may give hooked and broken wires, and such irregular grinding that accurate setting is impossible.

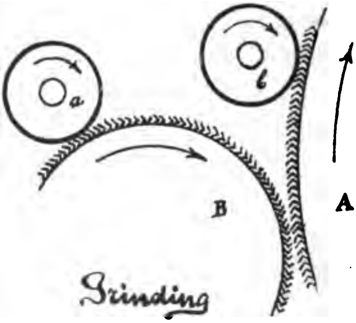
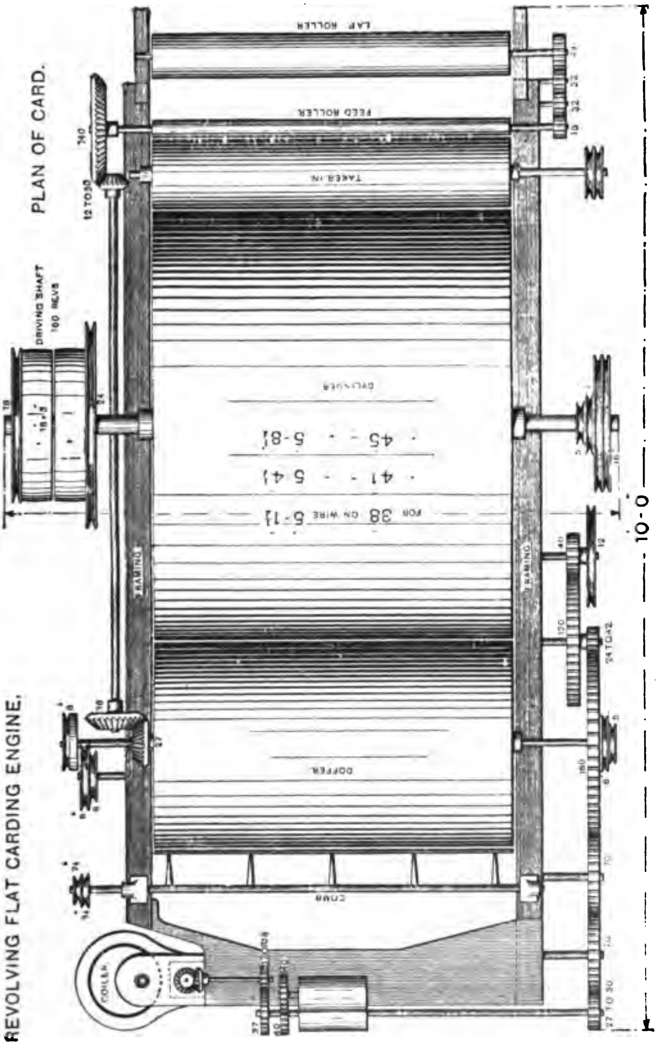


Fig. 64.

Fig. 64 shows the grinding of cylinder and doffer. A is the cylinder, B the doffer, *a*, *b* are the grinding rollers. It will be noticed that grinding is being done from the backs of the teeth, and that the grinding rollers revolve the opposite way to the cylinder and doffer. In this way a high speed of grinding is obtained.

Q. 1901. Between what points is the draft obtained in a carding engine? Describe the mechanism employed to drive the parts referred to, clearly indicating from whence each is driven.

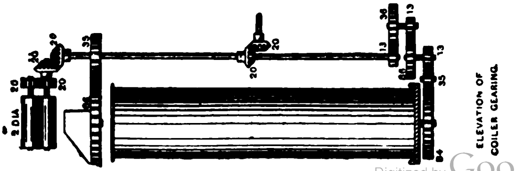
A. The principal draft of a card is between the doffer and the feed rollers. Very small drafts may often be found



REVOLVING FLAT CARDING ENGINE.

PLAN OF CARD.

FIG. 65.



DIAM. OF ROLLER.
38 IN. AND 41 IN. CARDS 2¼ IN.
45 IN. „ 2½ IN.

(1) between feed and lap roller, (2) between the doffer and calender rollers, (3) between the calenders and the top coiler rollers. It is a very common practice now to drive the doffer from the taker-in by a crossed or open belt, as the case may be. It is the general practice to drive the feed roller from the doffer as follows: A bevel wheel on the doffer end drives a bevel wheel on the side shaft. On the other end of the side shaft is the change bevel, which gears into and drives the large feed roller wheel. The feed roller drives the lap roller through the medium of a couple of carriers, besides the driver and driven.

The calender rollers are driven from the large doffer end wheel, and a continuation of driving from the calender roller shaft is made to the upright shaft of the coiler motion. The accompanying gearing plan (Fig. 65) will be found practically self-explanatory.

Q. 1898. The doffer of a revolving flat carding engine is assumed to be 26 inches diameter. It drives the feed roller by a side shaft and bevel gearing. The doffer shaft pinion has 24 teeth, the side shaft bevel 34, the side shaft change bevel 25 teeth, the feed roller bevel 120 teeth, and the feed roller $2\frac{1}{4}$ inches diameter.

From the doffer the calender rollers are driven by a wheel on the doffer with 180 teeth, which, by carriers, drives a pinion on the calender roller with 18 teeth, and the calender roller is 3 inches diameter. What is the draft between the feed roller and calender?

A. Several years ago the writer formulated and laid down a general rule for drafts in spinning machinery which is applicable to the question under discussion, and may be here very profitably repeated. It is as follows: "Taking simply the two points between which it is necessary to find the drafts, regard the wheel on the delivery roller as the driver of the feed, whether it be so or not. Divide the product of all the driving wheels or pulleys and the diameter of the feed roller into the product of all the driven wheels or pulleys and the diameter of the delivery roller." Applying the foregoing rule to the case in point, we get:—

$$\frac{3 \times 180 \times 34 \times 120}{2{\cdot}25 \times 18 \times 24 \times 25} = 90\tfrac{2}{3}.$$

Or the solution may be given in three parts, as follows:—

$$(a)\ \frac{26 \times 34 \times 120}{2{\cdot}25 \times 24 \times 25} = 78{\cdot}5\dot{7}$$

= draft between feed roller and doffer.

$$(b)\ \frac{3 \times 180}{26 \times 18} = 1{\cdot}1538$$

= draft between doffer and calender.

$$(c)\ = 78{\cdot}5\dot{7} \times 1{\cdot}1538 = 90{\cdot}66 \text{ as before.}$$

The preceding sketch in Fig. 65 will help to make this answer clear.

Q. 1900. A 12 oz. lap is fed at front of card, and is reduced to a ·16 hank sliver. What is the draft of the card?

A. We will first find the counts of lap by the usual rule of dividing the weight of one yard of lap reduced to grains into the standard 8·3.

(a)
7000
3
4)21000
5250 grains.

(b)
5250)8·3333333(·001587 = counts of lap.
5250
30833
26250
45833
42000
38333
36750

Then divide the counts of sliver by the counts of lap.

$$\frac{{\cdot}1600000}{{\cdot}001587} = 100{\cdot}7 \text{ card draft.}$$

Q. What is the usual arrangement to prevent the lap, when unfolding at the card, from being strained on the one hand, or not taken up fast enough on the other hand?

A. The usual arrangement for this purpose is to drive the lap roller upon which the lap rests at a definite rate of speed from the feed roller, which receives the cotton from the lap roller.

It is usual to arrange the wheel so as to have a very slight draft between the feed and lap rollers, say, 1·01.

There is a tendency for the lap to slip when it is nearly finished, and therefore very light, as it is always rotated simply by frictional contact with the lap roller. In this way the lap has often been strained at these times.

Recently, in order to prevent this evil, it has become more or less the practice to make the lap roller with coarse flutes, and in some cases to cover it with perforated tin, and so to make the lap stick better.

It may be noted that changes in the character of the cotton or in the amount of opening and scutching may affect the draft between the lap and feed rollers.

In one case that entered into the author's experience, new opening and scutching machinery was obtained, and it was immediately afterwards found that the laps were strained between the lap and feed rollers at the card.

Clearly this was due to the cotton being better opened, thus causing it to yield more readily to the slight draft.

Fig. 66 clearly shows the driving of the lap roller from the feed roller.

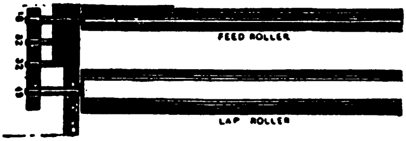


Fig. 66.

Q. A carding engine has a doffer 24¾ inches diameter, and a feed roller 2¼ inches diameter. On the doffer end is a 26 bevel wheel, driving a 32 bevel wheel on the side shaft. The side shaft change wheel is a 20 bevel wheel, driving a 154 bevel wheel on the feed roller. What is the draft?

A. The rule is to place the two driven wheels above the line for the dividend, and the two driver wheels below the line for the divisor.

The diameter of the doffer goes above the line, and that of the feed roller below the line.

$$\frac{24\frac{3}{4} \times 32 \times 154}{2\frac{1}{4} \times 26 \times 20} = 104{\cdot}24 \text{ draft.}$$

Q. What will be the weight per yard of sliver produced from a card doffer 12·65 revolutions per minute, working 50 hours, diameter of doffer $24\frac{3}{4}$ inches, including the wire? Weight produced from card, 700 lb.

A. (1) As there are 7,000 grains in one pound, the total grains produced by the card will be:—

$$7{,}000 \times 700 = 4{,}900{,}000 \text{ grains.}$$

(2) The total yards produced will be:—

$$\frac{24{\cdot}75 \times 22 \times 12{\cdot}65 \times 60 \times 50}{7 \times 12 \times 3} = 81{,}993 \text{ yards.}$$

(3) Clearly the total grains divided by the total yards will give the weight per yard in grains:—

$$\therefore\ 4{,}900{,}000 \div 81{,}993 = 59{\cdot}8 \text{ grains.}$$

Q. 1896. What is meant by "draft"? In what stages in cotton spinning is it found?

A. "Draft" may be defined as the "drawing-out" or "attenuation" of the cotton at any stage or process or machine, thus: If one inch of material be drawn into eight inches there is eight of a draft. There is probably some portion of "draft" in all the machines necessary for cotton spinning, although it is not requisite in doubling machinery. Roughly speaking, for about 36's yarn American cotton single roving there may be about the following drafts: Bale-breaker, 30; opener and scutcher, 3 or 4 each; card, 100; draw frame, 6; slubbing frame, $4\frac{1}{4}$; intermediate, $5\frac{1}{4}$; roving frame, 6 or 7; mule or ring frame, 8. These are only approximate drafts, but they show that draft takes place in all the machines. The same remark applies to the sliver lap machine, ribbon lap machine and combing machine used in fine spinning.

Q. 1899. A carding engine has a doffer 24 inches diameter, and a feed roller $2\frac{1}{4}$ inches diameter. The side shaft is driven by a bevel wheel with 24 teeth, driving side shaft bevel with 26 teeth; the other end of side shaft carries the change pinion, driving the plate wheel on feed roller with 120 teeth. Say what size of a change wheel is required to give a draft between feed roller and doffer of 95.

A.

$$\frac{24 \times 26 \times 120}{2{\cdot}25 \times 24 \times 95} = 14{\cdot}57.$$

Q. What length of card filleting $1\frac{1}{2}$ inches wide would be required to cover the cylinder of a carding engine 48 inches wide and 50 inches diameter?

A. $50 \times 3{\cdot}1416 = 157{\cdot}08$ inches circumference.

$157{\cdot}08 \times 48 = 7539{\cdot}84$ inches area.

If we now divide the area of the cylinder by the width of the fillet it must give the length of the fillet, thus:—

$7539{\cdot}84 \div 1{\cdot}5 = 5026{\cdot}56$ inches.

= 139 yards 1 foot 10½ inches.

It may be noted that the real diameter of the cylinder would be taken to the centre of the filleting thickness, which would slightly increase length of fillet required.

A more important consideration is that a portion of filleting is lost in making the tail ends when clothing the card.

To the length as calculated above we may therefore add one circumference of the cylinder, say, add 4 yards 1 foot 1½ inches, gives a total of 144 yards.

Q. Would the carding engine card a greater weight of cotton or less, and would the sliver be heavier or lighter in each of the following cases:—

(1) If a smaller pulley were used on the barrow wheel stud, this pulley being driven from the taker-in?

(2) If a smaller plate wheel were placed on the end of the feed-roller?

(3) If the wheel between the doffer wheel and front shaft wheel were decreased in size?

(4) A similar doffer bevel wheel?

A. (1) If a smaller pulley were put on the barrow wheel stud the card would get through a greater production, because it would speed all the feed and delivery parts of the machine, thus giving exactly the same result as putting on a larger barrow change wheel. The weight per yard or the counts of the sliver would remain the same.

(2) A smaller plate wheel on the feed-roller would have exactly the same effect as a larger side shaft change bevel—*i.e.*, it would diminish the draft, increase the weight, increase the production of the card in a proportionate manner.

(3) The wheel between the doffer wheel and the front shaft is only a carrier, and therefore a change in its size would not affect either the production of the card or the weight per yard of the sliver.

(4) A smaller doffer bevel would reduce the speed of the side shaft, and therefore give exactly opposite results to those obtained by No. 2 alteration. The draft would be greater,

the sliver would be lighter, and the production of the card would be diminished.

Q. 1900. What is "fly," and how is it created? At what points in the carding engine is it formed, how removed, and how often in the course of a day? What would happen if it were not properly removed?

A. This is a nice practical question. The waste made on a card may be roughly divided into two kinds, *viz.*, "strippings" and "fly". "Strippings" is the name given to the waste taken from the flats, cylinder and doffer. "Fly" may be defined as the waste which is thrown or which falls on the floor underneath the various parts of the card during working. The number of times that "fly" is gathered varies with different firms and different classes of work.

It is usual to gather taker-in "fly" more frequently than the other, and some people gather it once per day, some twice a day, others three times or four times, as the case may be. In some cases this "fly" is gathered at every stripping time.

The "fly" underneath the doffer and cylinder in some cases is gathered twice per week, and in other cases only once per week.

If the "fly" is not gathered with sufficient frequency it is possible for it to be caught up again by the working parts and to pass forward with the good cotton, and give a cloudy web. "Fly" is the fibre which is driven or which falls off the taker-in, cylinder and doffer during working.

RECEDING COMB.

For Stripping the Flats employed in Self-Stripping Revolving Carding Engines (Butterworth's Patent).

At the present time there is a strong tendency towards the adoption of patent stripping combs for the flats, and several motions are on the market, of which the one under notice is one of the cheapest and was one of the first invented. Other motions are Jones & Heap's, Walsh's, Fogg's, and Williams'.

It will no doubt have been observed that the comb always used for the above-named purpose, until recently, has an invariable and therefore non-adjustable up and down movement. The disadvantages of this principle are:—

1. *High Wires on the Flats.*—These are frequently caused

by the stripping comb, as when from want of proper care in grinding the flats are difficult to strip. It is a well-known custom to set the comb so as to touch the card wire on the down or stripping stroke, its combing action being however on the back of the tooth the angle of the wire is not disturbed; but on the return or upward stroke of the comb the wire is dragged back, with the result that the card teeth are straightened. It is quite true that this injury may be removed to some extent by light and careful grinding, yet the original power of the wire cannot be restored.

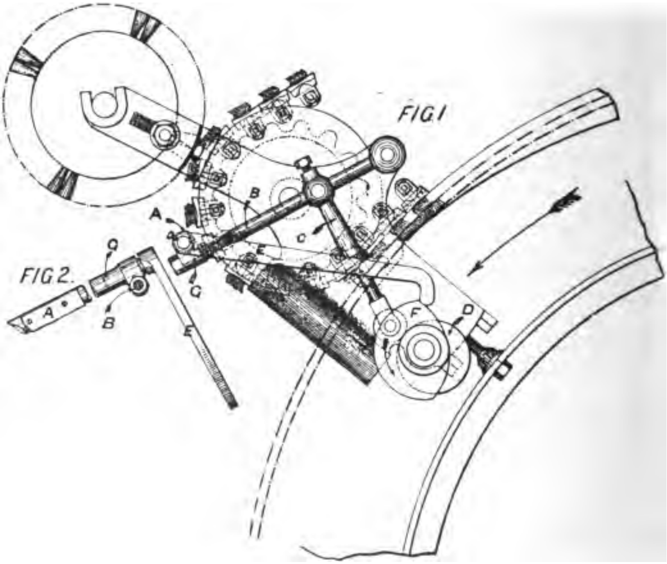


Fig. 67.

2. *Minimum of Strips.*—It will be noted under this old system that when it is deemed desirable to reduce the flat waste by making lighter strips the comb frequently fails to strip the flats altogether, which contingency can only be met by producing strips of a heavier character than are absolutely required, in order that the comb may effectively remove them from the flats. It is therefore obvious that

this method of setting produces unnecessary waste without improving the quality of the carding.

The patent receding comb here introduced removes some of the disadvantages of the old type of comb, from the fact that the principle of its construction provides for the process of stripping the flats being performed in the simplest and safest manner for producing the exact amount of waste that may be desired.

The action of this comb may be described as a double one, as, in addition to the ordinary movement, it possesses a receding movement from the card wire on the flats.

The construction and action of this comb will be understood by reference to the illustrations (Fig. 67) and explanations given thereon, namely—Figs. 1 and 2 representing that portion of a revolving flat carding engine to which the comb is applied; the comb being shown under letter A in front and side view. The teeth of the comb, A, move in the arc described by the stripping comb arm, B, by its connection, C, with the cam, D, as usual, but at the end of this downward or stripping stroke the patent mechanism, consisting of the additional lever, E, cam, F, and cannon bracket, G, come into action as shown in Fig. 1, producing a secondary or receding movement entirely maintaining the comb at a safe distance from the card wire during the upward or return stroke, preventing the possibility of damage being done to the wire. The auxiliary cam, F, then passes out of action, leaving the ordinary cam, D, to complete the down stroke, and so on.

The receding angle of the comb in relation to the card wire can be varied by the cam, F, if required.

The advantages *claimed* by the adoption of this comb are:—

(1) It permits of closer setting without damage to the card wire, for the reason that its secondary or receding motion draws or lifts the strips out of the flats before making the upward or return stroke.

(2) The possibility of angular setting with relation to the card teeth.

(3) By the withdrawing action at the termination of the downward stroke the strips may be reduced to an extent utterly impossible with the old type of stripping comb.

(4) The economy consequent on such lightened strips.

(5) All danger of contact with the card wire in the return stroke is removed by the receding motion of the comb, and effectually disposes of any liability of disturbance of the angle of the wire well known hitherto as the cause of "high wires" on the flats.

It must be understood that many practical spinners and carders do not think sufficiently well of any of the new motions to pay the extra money for them, and with good flats it is quite possible to set, say, ⅛ in. away from the flat and yet get good stripping. In some cases when flats get too slack one of them is taken out to tighten the chain. Some people object to the new combs because they are more complicated than the older form.

PLATT'S IMPROVED GRINDING APPARATUS.

For Revolving Flats of Carding Engines.

It is well known that the provision made in the flats under the former or old method of grinding was that each flat was provided with two surfaces, the upper or face side being termed the "carding," and the under or reverse side the "grinding" surfaces, these being most carefully adjusted by specially constructed appliances, whereby the high degree of accuracy obtained was accepted as a satisfactory method for meeting all requirements until a recent date. The demand, however, for a superior order of carding with a view to the production of higher class yarns has naturally led to a consideration of the best means of assisting in the attainment of the desired object by the improvement of the carding engine in any point that might still be open for so doing. In coming to this part of the engine it has been considered that the provision was inadequate for affording the required exactness, as it is clear that under the old system of carding from one surface, and grinding from another, irregularities must arise, by wearing on both surfaces, which ultimately destroy their original form, thereby rendering it impossible to set the flats to the required accuracy for good results. The apparatus here introduced removes the possibility of such conditions arising, there being but one surface subjected to wear. The wire will continue to be ground as at the outset by reason of the flats being supported from the same face in the same plane, and any difference in the height of the card wire will be removed by the action of the grinding roller; consequently, when the flats are in position on the "flat path" or flexible bend, all can be set by the same gauge to the cylinder.

The apparatus will be readily understood by reference to

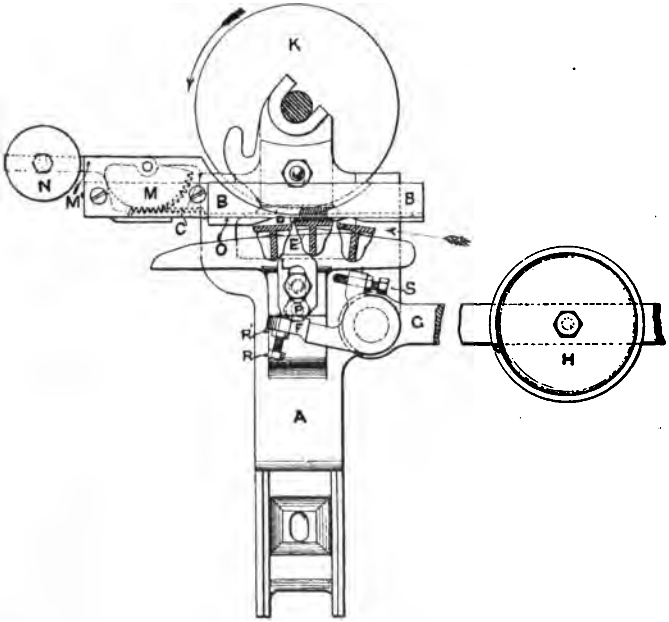


FIG. 68.

the illustration (Fig. 68), in which A is the grinding fixing; to this is fixed the bridge bracket, B, in which a rack and bar, C, slide; to this is attached a shoe, D, the lower surface of which is formed to the required bevel at which it is desired that the card wire shall be ground. The working or carding surfaces of the flats, E, are supported and regulated by the shoe, D, when grinding by the action of the lifter, L, and the levers, F and G, the opposite end of the latter being loaded by a weight, H. Each of the flats as it travels along seizes the "lip" or projecting end of the shoe, D, and is carried along until the wires have passed under the grinding roller, K, when the "flat" drops off the lifter, L, and releases the shoe, D, which immediately returns to its original position by means of the positive movement derived from the rack, C, quadrant, M, and weight, N. In case the flat, E, should not leave the shoe, D, at the right moment it will be carried against the fixed incline or stop, O, which will at once cause the flat, E, to release the shoe, D, with certainty. Every flat in the set is dealt with in the same manner, thus ensuring a uniformity in grinding that cannot be excelled.

The attendant must try every flat as it is lifted in the shoe, D, and set the lifter, L, with the setting screw, R, so that every flat is pressed tight in the shoe, D. Fig. 68 is Platt's special modification of Higginson and McConnell's grinding motion, which is also made by Dobson and Barlow and others.

Improved Stripping Brushes.

It has been stated that several improved methods of operating the flats stripping comb have been more or less adopted of late years. As is well known, it is the practice to have a revolving brush to clean the flats better after they have left the comb.

Lately several improved stripping brushes have to some extent been adopted, one of the best being Philipson's, shown in Figs. 69 to 70 (*b*). Instead of all bristles, it contains, as at G (Fig. 69), a few bristles only, and the rest of the periphery of the roller is almost covered with the wire teeth, B. It will be noticed that the bristles are sufficiently long to penetrate the wire teeth of the flats a little deeper than the wires of the stripper. The bristles can be readily renewed when sufficiently worn, and can be easily adjusted to penetrate the teeth of the flats more or less as required. At A (Fig. 69) is shown an apparatus used to clean the teeth of the stripping roller at intervals. This combination appears to be very effective, and not only does the work better, but is also more durable than the ordinary brushes, which require frequent singeing to keep them quite cylindrical.

Fig. 70 shows longitudinal views.

It is usual to drive this brush very slowly, say from five to ten revolutions per minute; and Figs. 70 (*a*) and 70 (*b*) show this slow driving. The large wheel, A, on the brush shaft is driven by the small pinion, B, the latter being driven by a thin rope.

Position of Fixed Bend of Card.

A most important feature of revolving flat cards is the position of the fixed bends. Formerly these were always placed as close as practicable to the cylinder edges, the intervening spaces being filled up with linings or flanges made of wood or iron, or both. None of these methods, however, have truly possessed the merit of curing the long-standing evil known as side waste.

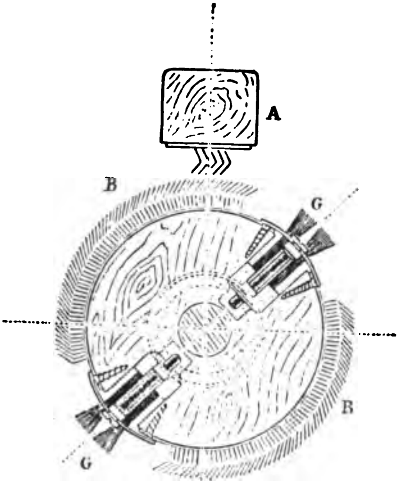


FIG. 69.

Probably the best remedy has been found in the placing of the fixed bends under the ends or inside the cylinder ends, thus bringing the flexible bends or flat course to the position formerly occupied by the wood linings.

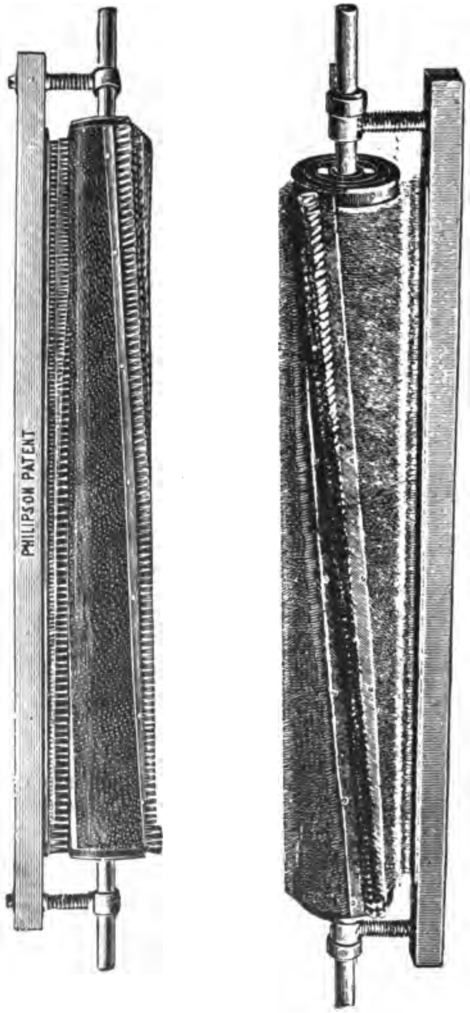


FIG. 70.

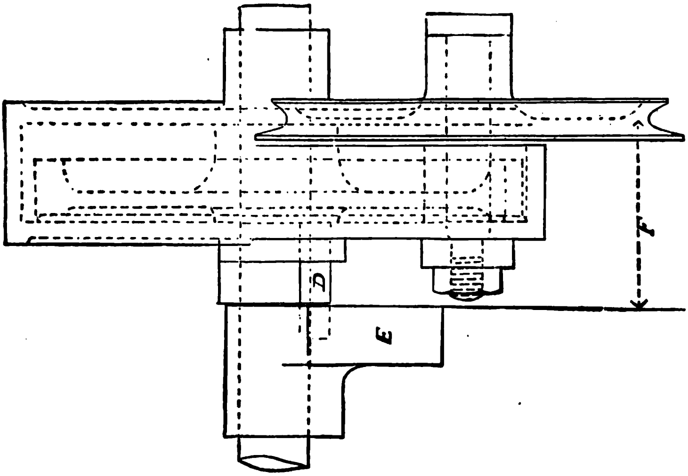


Fig. 70 (b).

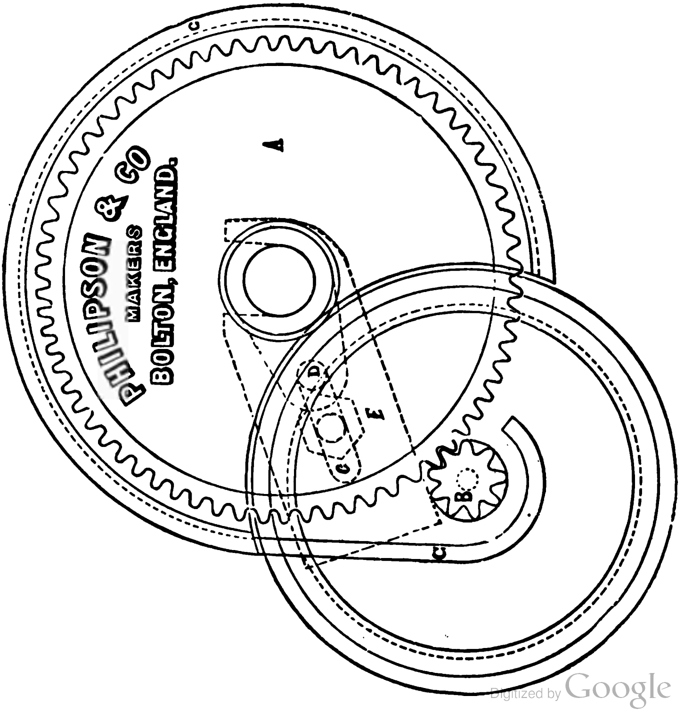


Fig. 70 (a).

Messrs. Platt's method of doing this will be understood by reference to the two sections shown (Figs. 71 and 72).

All the retained parts are indicated by corresponding letters, so that the changed position of the fixed bends with all that they carry will be apparent.

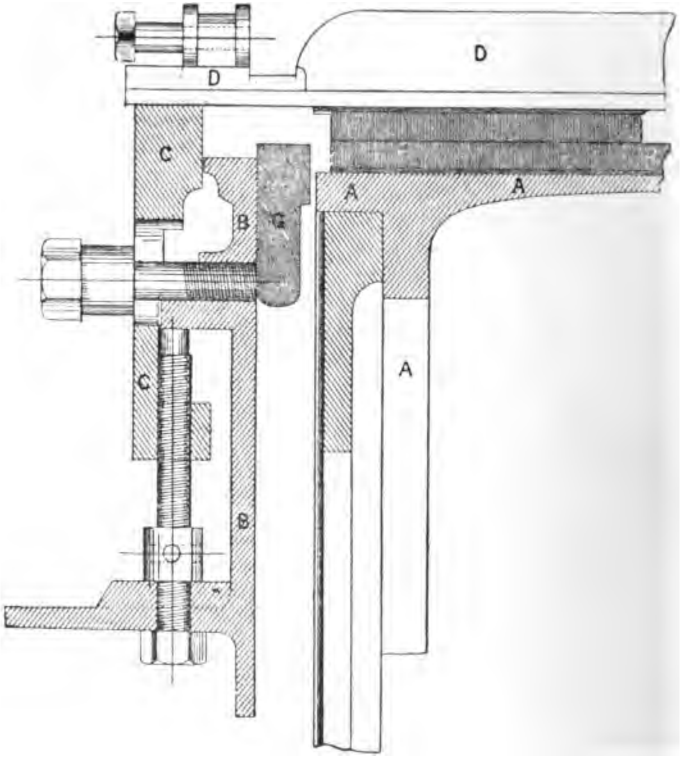


Fig. 71.—*Old Section.* A, Cylinder; B, Fixed Bend; C, Flexible Bend; D, Flat; G, Wood Lining.

The shortened flat thus obtained is less liable to deflection, the cylinder ends are better enclosed, and there is a tendency to give better selvedges and to reduce side waste to a minimum.

Referring to Figs. 71 and 72, it will be noticed that in the old section the *fixed* bend fulfils the dual function of carrying the *flexible* bend, C, brackets, etc., on the outside and a wood

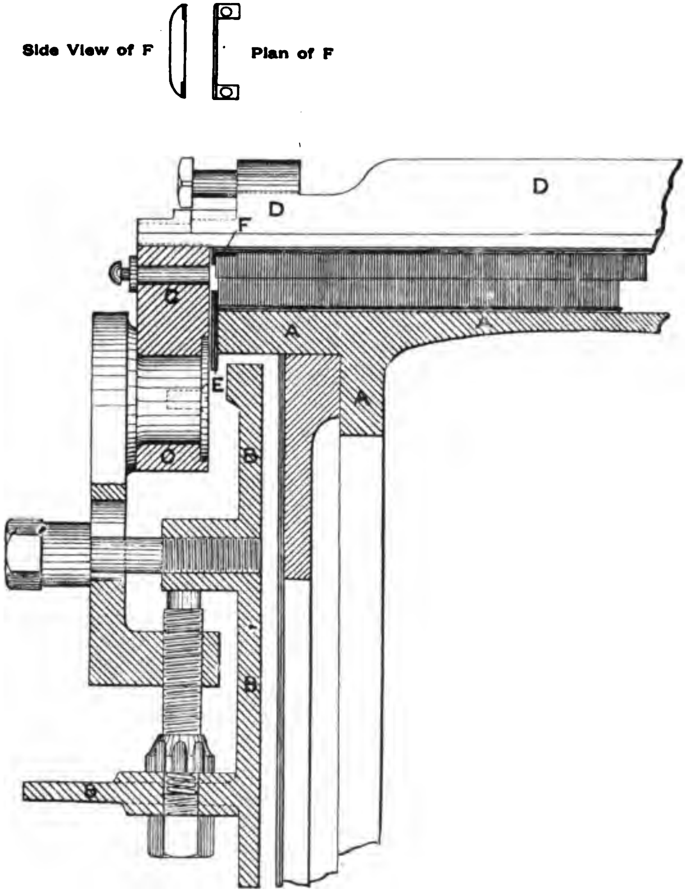


FIG. 72.—*New Section.* A, Cylinder; B, Fixed Bend; C, Flexible Bend; D, Flat; E, Flange; F, End Plates.

lining inside to fill up the space between the bend and cylinder, and it may be here said that until recently the only alternative for the prevention of side waste and flocking, was the wooden lining, which was not sufficient.

The cause of this defect probably lay in the large and exposed surface of the fixed bends to the action of the cylinder. The volume of air created by each of its revolutions became the disturbing influence, by reason of being pent up between the bend and the cylinder, thus leading to a condition which has been compared to a whirlwind.

When this action is present it is constantly abstracting cotton from the ends of the flats. The evil has probably shown itself worse since the introduction of high speeds and heavy productions, since it is reasonable to conclude that the higher is the cylinder speed the stronger is the current of air created and the larger is the quantity of side accumulation made.

Referring to the new section (Fig. 72), it will be seen that the fixed bend, B, is inside the cylinder, consequently the air made between it and the cylinder cannot very well escape so as to abstract cotton from the flats, this being prevented by the flange, E.

The flange, E, 1½ inches broad, really takes the position of the fixed bend in the old card, and its surface area exposed to the cylinder being so much less the currents of air generated are comparatively light in volume and are very liable to be dispersed into the atmosphere of the room.

From the position of the bend, B, flange, E, and *flexible* bend, C, it will be observed that if any side waste is made at all it will probably pass between the flange, E, and flexible bend, C, and on to the outside of the bend, B, and not be very likely to gather on the inside until it is rolled into lumps, as was formerly the case. It may be added that other firms have been working in the same direction.

Q. 1901. What are the dimensions of the chief parts of a revolving flat cardinal engine? After giving the answer to the above query, say what the area of the carding surface would be (*a*) on the cylinder, (*b*) on the working flats.

A. Revolving flat carding engines are made usually from 37 inches to 45 inches on the wire. Take a card at 38 inches wide on the wire:—

Feed roller, 2¼ inches diameter.
Taker-in, 9 ,, bare.

Taker-in,	9¾	inches diameter	with the wire.
Cylinder,	50	,,	uncovered.
,,	50¾	,,	with the wire.
Doffer,	24 to 27	,,	uncovered.
,,	24¾ to 27¾	,,	with the wire.

Area of wire on cylinder, calculating with bare cylinder,

$$= 3{\cdot}1416 \times 50 \times 38 = 5{,}969 \text{ square inches.}$$

Area of wire on the flats, taking 42 as working at one time,

$$= 38 \times \tfrac{7}{8} = 33{\cdot}25 \text{ square inches per flat.}$$

$\therefore$ $33{\cdot}25 \times 42 = 1{,}396\tfrac{1}{2}$ square inches for all the flats actually working at one time.

Q. 1901. The doffer of a carding engine is 26 inches diameter. The doffer wheel has 180 teeth, and drives by carriers a wheel with 25 teeth on the bottom calender shaft. The bottom calender is 3 inches diameter. The bottom calender shaft drives by a wheel with 37 teeth the coiler change pinion with 17 teeth. The coiler upright shaft is driven by equal bevel wheels, and on its head is a bevel pinion with 21 teeth driving a pinion with 20 teeth on the coiler calender roller shaft. The coiler calender roller is 2 inches diameter. What is the draft between it and the doffer?

A. Method I. :—

$$\frac{2 \times 21 \times 37 \times 180}{26 \times 20 \times 17 \times 25} = 1{\cdot}265.$$

Method II. :—

$$(a)\ \frac{2 \times 21 \times 37}{3 \times 20 \times 17} = 1{\cdot}523$$

= draft between calender and coiler top rollers.

$$(b)\ \frac{3 \times 180}{26 \times 25} = {\cdot}83$$

= draft between calenders and doffer.

$$(c)\ {\cdot}83 \times 1{\cdot}523 = 1{\cdot}264.$$

Q. 1901. What is the result if the teeth of the card clothing are either improperly shaped or roughly or badly ground? Give reasons for your answer.

A. The best shape of the wire tooth has always been one of the principal points to receive the attention of card clothing manufacturers.

There are several varieties of what are often termed "fancy wires," such as round, angular, convex and flat wire. Such wires have their shapes given to them by passing the wire through steel rollers, so as to press the wire into the required shape.

One of the most satisfactory forms of tooth is made with a round section below the knee or bend, and then from the bend to the apex of the tooth; the sides and back of the tooth are tapered so as to give a fine point. If the teeth were also tapered on the under or front side the fibres would tend to slip off. The amount of waste is often affected by the shape of tooth, and perhaps even more so by the amount of "keen" or bend given to the tooth.

Although there are some eminent users of Egyptian cotton who still prefer to use mild wire, most other users of the same kind of cotton, and practically all users of American cotton, prefer to use hardened and tempered steel wire, which possesses the advantages of greater rigidity, hardness, resilience and ability to retain a sharp point longer than mild wire. In addition, it enables a stronger cloth foundation to be used.

In some cases with new cards clothed with hardened steel wire great difficulty has been experienced in getting the cotton to pass properly through the card, owing to the wire being too rough and scaly. A great deal of this kind of trouble was overcome by the introduction of methods of hardening and tempering of the wire in vacuum, or by open gas flame or by electricity.

If cottons are hard, stringy or neppy it is especially necessary to have a keen edge and cutting point on the wire, as dull, thick points will not act efficiently on such cotton. Although it is requisite to put the clothing on the card at a good firm tension, care must be taken not to strain it during covering, or to pull the teeth back. Sometimes in grinding the wire teeth have been so heated as to fuse. If the teeth are not ground level across the card it will be impossible to get uniform and close setting.

Neglect of stripping and grinding will leave the teeth so charged with fibre or so dull that they refuse to clean the cotton properly, and leave more short fibre in sliver, the result in either case being a dirtier and duller yarn. Sometimes the wire teeth are crossed or otherwise damaged by the cylinder teeth.

"Breaking out" of the wire, or "rough" wire, both cause dirty carding. Roughness of wire and want of sufficient angle in the wire cause the cotton to stick too much to the wire and to give dirty carding.

Q. 1901. At what points in a carding engine does damage to the cotton most usually happen, and what are the principal reasons for its occurrence?

A. A good deal of information given in the immediately preceding answer applies equally to this question.

Often the sliver from a card comes off in a dense, cloudy manner, there being quite a number of possible causes for this. In many cases it has been proved to be due to the lower edge of the back plate being so far away from the cylinder that it has allowed fibres of cotton to lash out and stick to the edge of the plate, and be taken forward by the cylinder in an irregular manner. With old cards cloudy webs have been probably sometimes caused by the influence of air currents acting on the surface of the cylinder, but with new cards it is not likely that this can often occur. Too wide setting of other parts, as well as neglect of stripping and grinding, may cause cloudy and dirty webs. Rubbing of some parts may cut, nep and lacerate the fibre, as well as spoil the wire. A good deal of damage has been done by imperfect setting and action of the patent grinding motions for grinding the flats from their working surface.

In some cases the front and back plates of the card have not been made sufficiently strong, and the flexibility and buckling of the plates, resulting from their weakness, has been the cause of unequal strips, cloudy webs and rubbed wire. There are many who still consider that the use of hardened wire torments the fibres, and others think the fibres are cut and otherwise damaged by the licker-in speed being too high.

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